INSTRUMENTS AND CONTROL SYSTEMS

INCLUDING: INSTRUMENT MANUFACTURING • JOURNAL OF THE SCMA • SIMULATION COUNCIL NEWSLETTER

in this issue:

OCTOBER 1959

Oscilloscope-Camera Recorders 1520
Pressure Recorders 1526
The EDA 1532
Process Control Systems 1535
High Resistance Padded Resistors 1536
Seismograph Structures 1541

PART ONE OF TWO PART ISSUE

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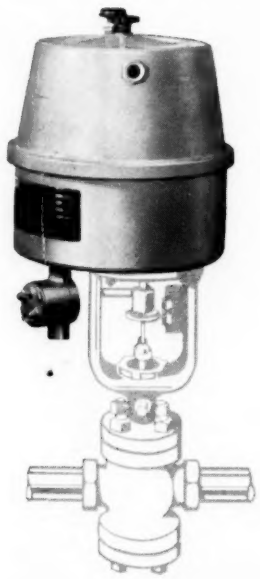

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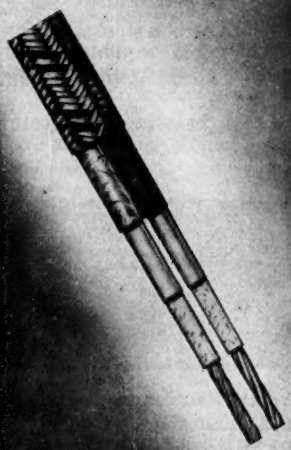

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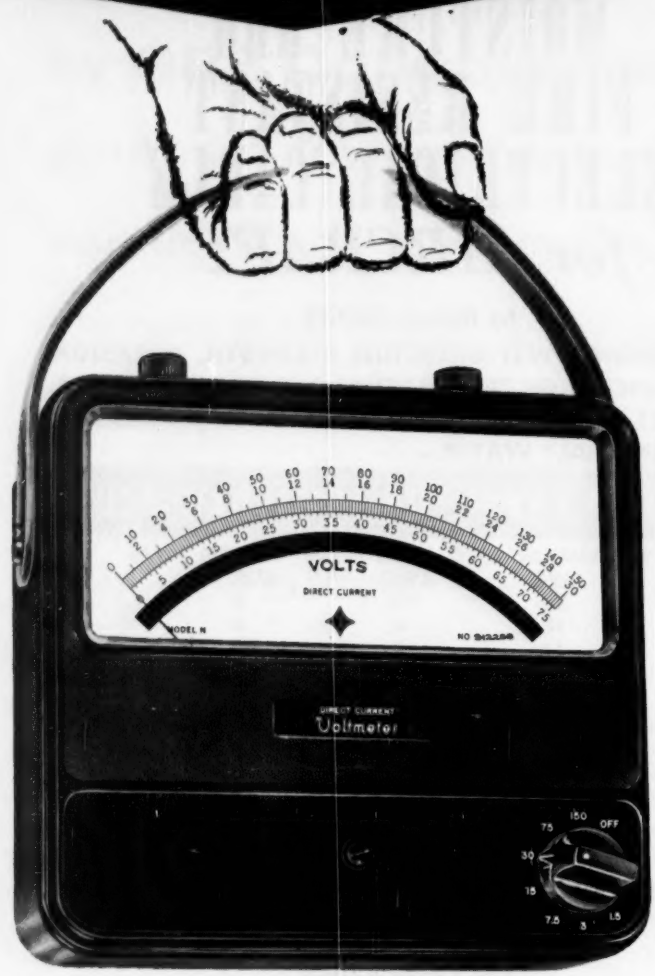
SENSITIVE RESEARCH



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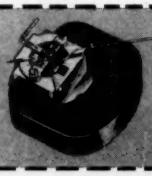

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CIRCLE 3 ON READER-SERVICE CARD

INSTRUMENTS AND CONTROL SYSTEMS

Formerly INSTRUMENTS and AUTOMATION

OCTOBER 1959

VOLUME 32 NUMBER 10

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Oscilloscope-Camera Recorders, 1520

SURVEY discusses technique of using cathode-ray-tube and camera recorder for recording signals above 5000 cps

Pressure Recorders, 1526

SURVEY of pneumatic-signal types including static-pressure, differential-pressure and receiver

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Seismograph Structures, 1541

RUDOLPH F. HAUTLY and CARL KISSLINGER—various constructions designed to establish stable reference point with respect to which ground motion can be measured

PART TWO

All-new 1960 **Instruments and Control Systems Buyer's Guide**, listing the products of over 2000 manufacturers of instruments, controls, components, and accessories, is the companion volume to this October issue.

Continued on page 1454

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CIRCLE 4 ON READER-SERVICE CARD

INSTRUMENTS AND CONTROL SYSTEMS

VOL. 32 No. 10 OCTOBER, 1959

PRINT ORDER THIS MONTH: 33,000

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CIRCLE 5 ON READER-SERVICE CARD

from
Instrument Calibration
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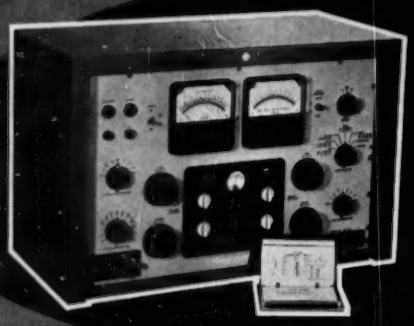

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CIRCLE 6 ON READER-SERVICE CARD

to the editor

Editor, I&CS:

Concerning the article in the June issue entitled "Recording Interferometric Dilatometer", I believe there is an omission. I attempted the modification as it was illustrated and described and found it inoperable.

As it is set up the real image will be found at the exit pupil or eye ring, but the width of the fringes at this point are very much smaller than 1/16″ which is the indicated diameter of the entrance pupil to the phototube assembly. In order to obtain the $\cos^2 x$ curve the individual fringes must be at least as wide as the 1/16″ diameter hole. Magnification of the fringes, thus, is necessary. A lens of suitable focal length must be added between the eye ring and the entrance pupil. It should be a distance beyond the eye ring that is a little more than its focal length. The correct position of the entrance pupil can also be located. It is now operable.

This adaption has been confirmed by the Gaertner Scientific Company.

David J. Scanlon
Instrument Engineer
Pratt & Whitney Aircraft
Middletown, Conn.

The author replies:

Editor, I&CS:

In reference to the enclosure to your letter of 11 August, 59, the modification to our apparatus, described by Mr. Scanlon is really not necessary. There are two factors which he could have controlled that would have corrected the situation. We believe that the inclination between his two interferometer plates was too steep, giving rise to a larger number of fringes than we used. Also, if he had moved his receiver back farther, magnification of the fringes would have resulted since the Gaertner instrument is already equipped with a suitable lens.

We are pleased with the response to our article.

Irving N. Greenberg
U.S. Army Signal R & D Laboratory
Fort Monmouth, N. J.

Editor, I&CS:

Having been a continuous subscriber to *Instruments*, etc., since 1938, I have all the copies from 1942 —those previous were strung

throughout the Navy. These are invaluable for research or rereading an article, if the date can be remembered. I would like to suggest that additional "Index to Volumes" be made available to subscribers. In this way the volumes can be stacked separately and the indexes filed in sequence in another folder.

Wishing you continued success in the Instruments Publishing Field.

Enclosed is $29.00 for eleven books.

Wilbur E. Statler
Hagerstown, Md.

Editor, I&CS:

I have learned from Mr. Coyle of the U.S. Office of Education that you have developed some excellent courses in the field of instrumentation.

We are presently exploring functioning programs, curricula and current literature in this field with a view to further program development in Wisconsin. We would appreciate information concerning your studies and programs.

Donald M. Brill, Supervisor
Trade and Industrial Education
Madison, Wis.

Editor, I&CS:

The July issue of *Industrial Editor* arrived this morning. I did not put it down until I had finished reading your article "What is the Author Trying to Say?" It was most helpful.

Thanks for your clear, well illustrated sketch of the production and education functions of a technical editor.

Cliff Thompson
Rockwell Manufacturing Co.
Pittsburgh, Penna.

Editor, I&CS:

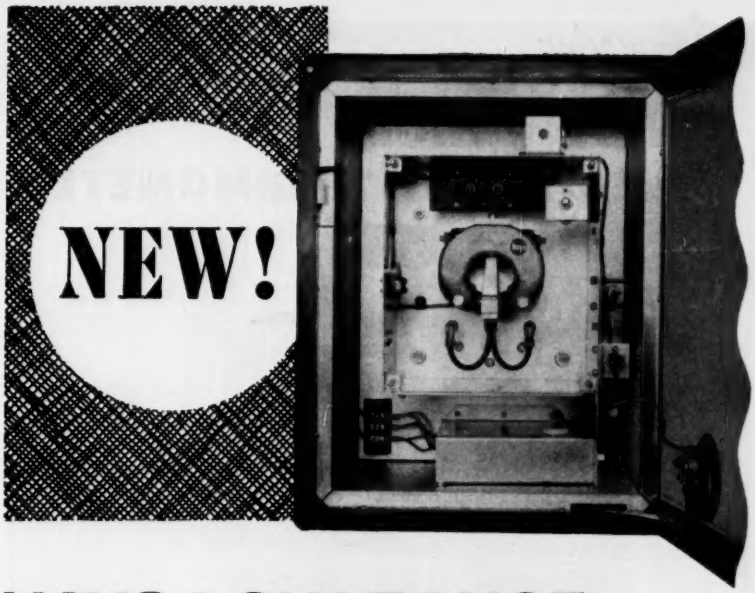
May I have a copy of the article, "Report on Public High-School Course in Modern Engineering Physics" which appears in the February 1959 issue of *Instruments and Control Systems?*

Robert L. Thing
Instrument Engineering
Mason-Neilan
Norwood, Massachusetts

Editor, I&CS:

Please send me two copies of "Report on Public High-School Course in Modern Engineering Physics."

Seth H. Parsons
New Mexico Highlands University
Las Vegas, Nevada



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CIRCLE 8 ON READER-SERVICE CARD

LETTERS—CONTINUED

Editor, I&CS:

I have read your article "Weight" in the December 1958 issue. In your Table 3 you list various drifts in steel. Also previously you mentioned a hysteresis effect in spring steel. These figures seem excessive in view of the results we have had here when working with tool steel.

We would appreciate receiving your original source of information . . . the original test data in question.

We have done a considerable amount of work here developing a differential transformer type of load cell to be used with our storage tanks. It was thus with a great deal of interest that we read your very fine article. We know this must have taken a great deal of research, and we believe it was very well presented.

J. A. Perry
Manager, Automatic Controls
Cherry-Burrell Corp.
Cedar Rapids, Iowa

The spring-steel data are averages for hard drawn, music, oil tempered and high-carbon steels. The latter would show the least hysteresis, less than that indicated in the table.

Editor, I&CS:

The reprints of Mr. Moeller's article "Welding a Thermocouple Junction" arrived in good shape. We have received more than a dozen requests. So obviously *INSTRUMENTS AND CONTROL SYSTEMS* has excellent readership among people interested in this field.

I hope we will have another suitable article sometime soon in which case I will surely shoot it along to you.

Odom Fanning
Midwest Research Institute
Kansas City, Mo.

Editor, I&CS:

As a school board member, reasonably active from local to national levels, I was much interested in your "Anti-Hardwarism . . ." editorial in March *I&CS*. (I am going to ask our librarian to get your February issue, which for some reason is missing). This is a pungent item.

I like your approach. (I happen to be an elementary board member—but am on several state committees, including an alumni advisory committee, because I contend the University should articulate to Elementary Junior High on motivation and follow up problems.) We have

had a special mathematics laboratory, in one of our three elementary schools, using some laboratory techniques for aids in teaching Math. at 7 and 8th grade levels, with a few trials down to the 4th grade.

Is it possible that the "Vocational" tinge you report is the result of instruction rather than "hardware"? Perhaps "hardware" is like the passive book, up to now the greatest aid to education, or like E.T.V., a medium that allows the really better instructor to do a better job for many many more students. "Electronic Aids to Education" (my penchant), are passive but revolutionary in the hands of the superior teacher.

How does the achievement of your students compare as matched pairs?

Your article is very fine. Perhaps you have some ideas on instrumentation-learning-motivation at the Junior High Elementary level in education, where I believe the real scientists and engineers are first made, and where students develop the real love and joy of learning, intangible as it is.

I was pleased to see what I thought was a good educational article in a non-educational magazine. It was indeed well done, and I hope more educators will see it.

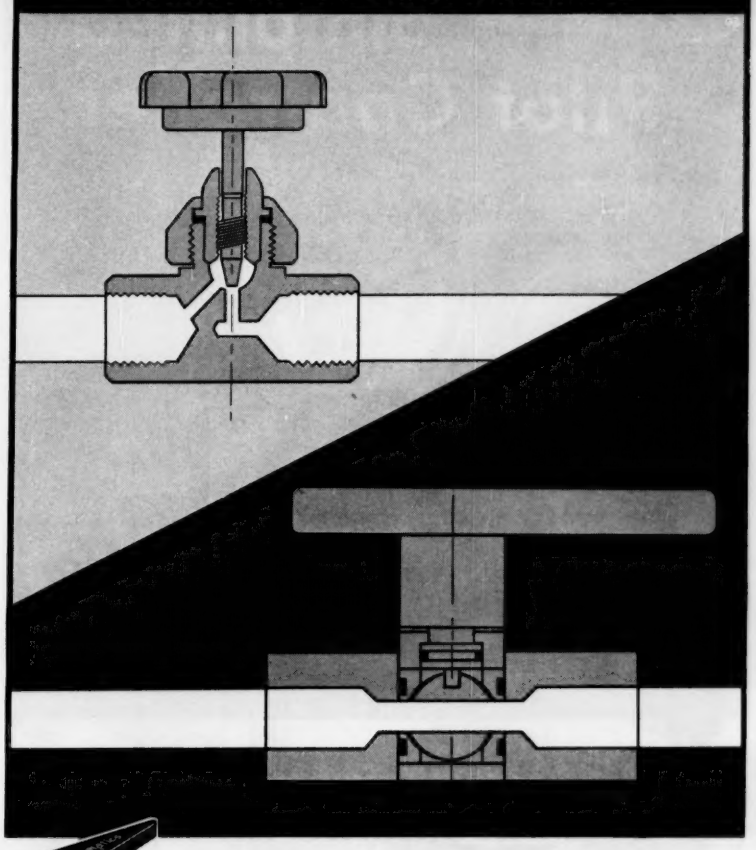
Lloyd P. Morris
Motorola, Inc
C&IF Division
Chicago, Ill.

As the students in the class were of high IQ, any comparison with other students is difficult to assess. These students volunteered to travel across a city twice a day to take 2 extra hours of academic instruction per day—in addition to their regular academic program. One would expect them to do well anywhere. However, the reaction of the students, lecturers, and teacher (particularly) are meaningful; they are included in the Report.

As to fundamentals—the equipments and hardware were used only to show practical examples of modern fundamentals at work, and only after the fundamentals were covered by teacher and lecturers. This type of motivation is essential at the high-school level, where increasing percentages of students are being repelled from, rather than attracted to, science and engineering.

We agree that the problem of student motivation occurs below the level of the college—but the colleges, who control high-school curricula, don't know it. Use of instrumentation (hardware) is one of the most effective motivation practices at all levels.

FLO·BALL 715
makes needle valves obsolete



Which valve has 100% flow efficiency?

100% flow efficiency — an unrestricted straight-thru fluid path — is another feature of the Hydromatics ***FLO•BALL 715,*** shown on the bottom. That's more than **double** the flow efficiency of needle valves. Furthermore, a fast quarter turn moves the ***FLO•BALL*** from open to closed position; instant action at flow pressures up to 3,000 psi with just 4 inch-pound torque! And the arrow-shaped handle provides positive on-off indication.

Ideal for leakproof control of air, vacuum, steam, water, fuels, oils, kerosene, alcohol, etc., the ***FLO•BALL*** features zero leakage, universal mounting, removable flanges, and all stainless steel construction.

Write today for a complete catalog describing this valve and others for corrosive and cryogenic media. Also special designs for throttling flow control.

The *FLO•BALL* costs no more than old fashioned screw-type valves!

Exceptional engineering employment opportunities—write today!

Hydromatics, Inc.

LIVINGSTON, N. J. • WYMAN 2-4900 • TWX = LIVINGSTON, N. J. 120

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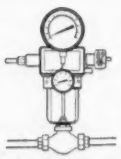
CIRCLE 9 ON READER-SERVICE CARD

Remote Control of Temperature or Pressure with TRUE Proportional Band Adjustment

Now, the simplest *true* proportional band adjustment in the field . . . a compact, inexpensive unit for positive remote control of temperature or pressure in countless applications. Fast-response bulb sends three- to fifteen-pound air signal to control valve, damper actuator or other control device. Long-life dependability ends pilot control headaches. Available as "blind" or indicating controller.

- Convenient knob adjustment
- Low air consumption
- Small, highly sensitive element
- Simple field reversibility
- True proportional response
- Any 50° range, −20° F. to +380° F. Pressure: 3-35 psi; 5-75 psi; 15-150 psi.



Can be supplied factory mounted on control valve

FOR COMPLETE INFORMATION, WRITE FOR BULLETIN TL-113

Robertshaw-Fulton
CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tennessee

CIRCLE 10 ON READER-SERVICE CARD

Editor, I&CS:

Could you please explain what the diagram used to head the Simulation Council newsletter in your magazine is intended to represent. In our instrument shop here we are of differing opinions as to whether it represents a control system, a process, or a combination of both. What the individual symbols represent, is also a mystery which you might clear up for us.

B. W. Littlejohn
Ocean Fall B. C.
Canada

Editor, I&CS:

As a regular reader of *Instruments and Control Systems* I shall be highly grateful if you kindly let me know the details and the American Universities for which I have to apply to get a Doctorate or Master's degree in Instrument Technology.

Regarding my educational qualifications let me state briefly that I passed the B. S. C. Degree examination of the Madras University (India) in the year 1952 with physics as main subject and mathematics and chemistry as subsidiaries. Further I have taken the post-graduate diploma of the Madras Institute of Technology (D.M.I.T.) in Instrument Technology in the year 1956. This is a three year course after graduation and comprises theory, design, calibration and maintenance of various types of Electrical Mechanical, Industrial, Optical, Electronic, Air-craft, Time-measuring, etc. instruments. Also I am a member of the "Society of Instrument Technology" (London). I am now working in the Instrumentation department of the Central Fuel Research Institute as a scientific assistant for the last 22 months.

L. J. Krisnamurthi
Central Fuel Research Institute
Jealgora P. O.
Dhandat dt.
Bihar, India

Editor, I&CS:

Do you have reprints of your editorials on education published in February and March entitled: "Report on Public-High-School Course in Modern Engineering Physics" and "Anti-Hardwarism?" If so, may I have a copy of each?

They are *good.*

J. W. Krewson
Instrument Department
Oak Ridge National Laboratory
Oak Ridge, Tennessee

In the December, 1955 issue of this publication, we reported that Dr. Jerrold Zacharias and colleagues at the Massachusetts Institute of Technology had developed the first atomic clock. Subsequently we reported the several developments of this clock, including its production by the National Company of Malden, Mass.

Hence we were startled to discover that the Soviet Union awarded its Alexander Popov Gold Medal to Dr. Louis Essen of the British National Physics Laboratory, for Essen's work in establishing an atomic frequency standard. We have asked Dr. Zacharias to clarify this situation, and Dr. Zacharias responds as follows:

Editor, I&CS:

You are right to be confused by the recent award to Dr. Essen. The facts are simple. Some colleagues and I, in fact, made the first atomic clock. That clock has subsequently been put into production by the National Company of Malden Massachusetts, and they have sold a great many. At the present time they are, without question, the most precise clocks in the world—more precise than Essen's or anybody else's. But Essen had one other very important thing. He has access to the frequency control station of the National Physical Laboratory, which frequency was compared directly with astronomical timing. We did not have that frequency in our laboratory because the American equivalent is maintained in Washington, D. C., and that is not near enough to Cambridge, Mass., for a direct comparison.

Before Essen started his work with cesium clocks, he made a tour of this country and spent some time at my laboratory. His own clock was made after studying what other people in this country were doing.

None of this is adverse to Essen's accomplishment. His work is serious and extremely good . . . This letter has been written merely to clarify the situation.

Jerrold R. Zacharias,
Massachusetts Institute of Technology
Cambridge, Mass.

Where
high Performance
is vital, specify...
BREEZE BELLOWS
Because BREEZE Bellows are job engineered for the most exacting applications, they insure high performance and long life. BREEZE offers a wealth of experience in weldable alloys such as Iconel X, titanium, Ni-Span, Hastelloys and Stainless steels. BREEZE Bellows solve tough problems in instrumentation, fuel regulation, pressure switches and expansion joints, hot air ducting, pressure surge tanks, packless valves, oscillating and rotating shaft seals, atomic and nuclear reactors.
We invite your inquiries.
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700 LIBERTY AVE., UNION, N. J.
BREEZE PRODUCTS: ACTUATORS • HOISTS • TRANSMISSIONS • GENERATORS • STARTERS
STARTER GENERATORS • BELLOWS • SLIP RINGS • HOSE CLAMPS • HITEMP FLEXIBLE TUBING
CIRCLE 11 ON READER-SERVICE CARD

reader inquiries

Hardening by Induction Heating High-Temperature Control

Vice president (R & D) of photographic equipment manufacturer seeks contact with manufacturers of equipment for (1) hardening of steel by induction heating, and (2) electronic control of high temperatures. A-430

Pressure Gage Movements

Research associate in University aeronautical lab wishes to buy pressure gage movements. A-431

Semi-Conductor Test Equipment

Manufacturer of components using semi-conductors seeks test equipment. A-432

Metal Locator

Engineer in Brazil wishes to contact manufacturers of metal locators. A-433

Thermocouples for Nuclear Reactor

Instrument engineer on experimental nuclear project wishes to receive information on operable thermocouple installations in nuclear reactors. A-434

DEKORON ARMORED INSTRUMENT HARNESS

4 + 4 = 16

TUBE MATERIALS + TUBE CONSTRUCTIONS = DIFFERENT TYPES

Yes, *four* different core tubing materials (copper, aluminum, polyethylene, nylon) combined with *four* distinct types of armoring give you *sixteen* different types of Dekoron Armored Instrument Harness from which to choose.

Designed specifically for instrument harness application, special Moore-Loc armor construction has almost twice the pull-apart resistance of ordinary armoring . . . has cord packing for extra resistance to moisture and fume penetration.

There's at least one best type of Dekoron for your installation. We help *you* select it; we're unbiased because we make all types. Now go Dekoron 100% for all your tubing needs. Think of Dekoron first . . . to last. That's *Dekoron—America's Premier Line of Armored Instrument Harness.* A-314A

CONSTRUCTIONS

TYPE VA

For Impact and Corrosion Resistance. Core tubes with vinyl sheath covered with Moore-Loc modified-square-lock construction armor with cord packing.

TYPE VAV

For Impact and Maximum Corrosion Resistance. Same construction as Type VA (*above*) but with outer vinyl sheath. 24-gauge galvanized steel armor gives maximum pull-apart and impact resistance.

TYPE A

For Impact Resistance in Dry Locations. Core tubes are wrapped in vinyl-impregnated insulating tape. Tape insulates and cushions core tubes inside metal armor.

TYPE AV

For Corrosion and Impact Resistance. Same construction as Type A (*above*) but with outer vinyl sheath. All four constructions available with metal or plastic core tubes.

Dekoron® products QUALITY • RESEARCH • SERVICE

SAMUEL MOORE & COMPANY

DEKORON PRODUCTS DIVISION • MANTUA, OHIO

CIRCLE 12 ON READER-SERVICE CARD

trends

Market for silicon solar cells is now about $4.5 million annually, but should increase 25 times by 1970, says R. F. Edwards of International Rectifier Corp.

Industrial commercial electronics market was $676 million in 1950, $2.46 billion in 1959, may reach $6 billion by 1970, says H. Hoffman of Hoffman Electronics. Also, present $4.5 billion military electronics market may reach $10 billion by 1970. Parts, repairs and services market is now $2.6 billion; may reach $3.6 billion by 1970.

Japan enters computer field, with 50 computers to be made in 1960, 100 in 1961, 50 more each succeeding year.

Space electronics market in 1959 is $200 millions, says A. D. Little.

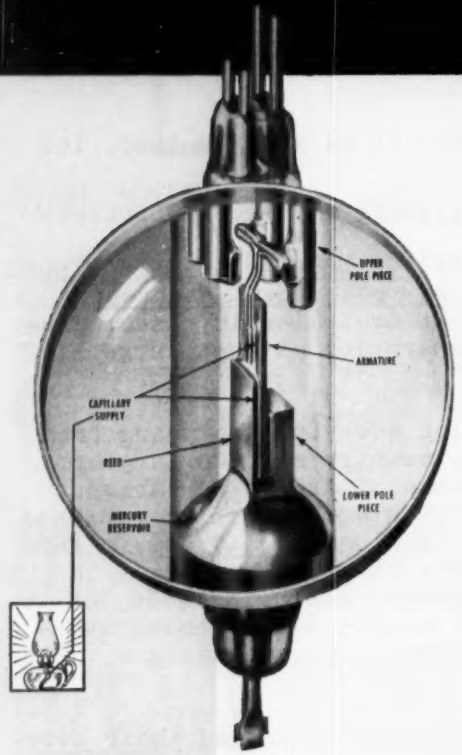
Officials of Air Material Command state that 163 bases will be equipped under a six-million-dollar Air Force precision measurement and repair program. Laboratories already are operating at most missile bases. Precision calibration laboratories will be in operation at most large Air Force bases by end of 1959.

A 23.5% increase in corporate aid to education over the two years from 1956 to 1958 was revealed in a survey of the country's 1,500 largest corporations released by the Council for Financial Aid to Education. The gains were noted in a control group of 215 companies which reported grants to higher education in both years, totalling $33,140,806 in 1956 and $40,917,571 in 1958. The highest average gift per company was in the electrical machinery field, with 11 companies averaging $336,366 in educational grants for 1958. Chemicals were second, 25 companies averaging $247,371 apiece. Tobacco was third, 3 companies averaging $247,353 apiece.

U. S. precision instrument manufacturers continued to expand their oversea market during 1958, reaching a new sales peak of approximately $231 million (in contrast to $217 million in 1957, $164 million in 1956, and $128 million in 1955) reports BDSA, U. S. Department of Commerce. Indicating, measuring and control instruments represented four-fifths of the oversea sales, or $185 million ($114 million were mechanical measuring type; $42 million geophysical, navigational, nuclear and related instruments; $29 million electrical measuring; scientific, research and engineering instrument group $46 million, including laboratory equipment of $24 million, optical $11 million, horological $8 million, and surveying instruments $3 million). Note: only laboratory, optical and horological oversea sales declined—due to European and Japanese competition.

Ten largest oversea Instrument markets, says BDSA, were Canada $66 million; Venezuela $17 million; Mexico $10 million; Brazil $8 million; Cuba $4 million; Japan $17 million; France $10 million; Germany $9 million; Italy $9 million; and United Kingdom $7 million. Australia, Netherlands, Sweden, Belgium, and India each purchased from $3 to $4 million U.S. instruments last year.

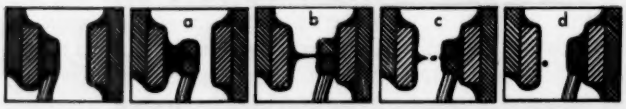
*with contact load of 250 volt-amperes.



NEVER WEAR OUT

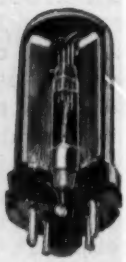
Longevity is built into these relays. The basic magnetic switch is sealed in a glass capsule filled with pressurized hydrogen. With every make and break the mercury-film contact surface is renewed . . . by capillary action, like a lamp wick. These contacts never get dirty, never lock or weld and *NEVER WEAR OUT.*

NEVER CHATTER OR BOUNCE



Contact closure between the two liquid surfaces bridges any mechanical chatter and prevents its appearing in the electrical output. (a) Filament of mercury forms between the contacts as they separate. (b) This becomes narrower in cross section and (c) finally parts at two points, allowing a globule of mercury to fall out. (d) The extremely fast break minimizes the arc and adds greatly to contact load capacity.

NO MAINTENANCE REQUIRED



HG Relay cutaway to show magnetic switch surrounded by operating coil and encased in a metal housing.

HGS Relay cutaway to show biasing magnets attached to the ends of the side plates.

HG6F Relay printed circuit panel showing six in-line mercury-wetted contact switches mounted in minimum space.

With all working parts sealed and switches and coils enclosed in metal housings, these relays are tamper-proof and always in constant adjustment. They require no maintenance whatsoever.

CIRCLE 12 ON READER-SERVICE CARD

news

Mobot Makes its Bow

LOS ANGELES, CALIF.—The Mobot Mark I is a combined manipulator and mobile cart, all controllable from a remote location.

Developed and built by Hughes Aircraft Co. for the Sandia Corp., direct contractor for the AEC, the mobile

White-Room Efficiency Report

BIDDEFORD, MAINE.—Baker Co. which had erected a white room (shown in picture) for Sperry-Farragut Co., Bristol, Tenn., to protect the assembly operations of ball bearings from air contaminants, recently published a report which Armour Research Foundation had been called upon to write on the effectiveness of the measures taken.

A FULL LINE OF THE MOST RELIABLE, MOST DURABLE RELAYS EVER MADE

single form D

Type HG. Capable of up to 100 operations a second. Load-handling capacity to 5 amperes and up to 500 volts. (250 va max. with proper contact protection.)

single form D

Type HGP. Can be factory adjusted to provide single side-stable, bi-stable or chopper characteristics.

single form D

Type HGS. Biased with permanent magnets. Speed up to 200 cps. Sensitivity as low as ±2.5 milliwatts. Handles up to 2 amperes, up to 500 volts (100 va max. with proper contact protection.)

four form D

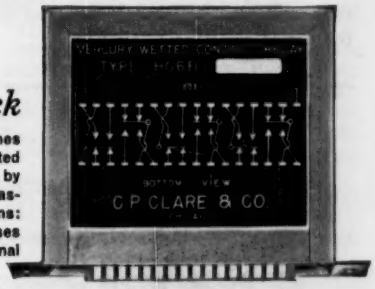
Type HG4. Four form D switches enclosed in a single housing with coil. Plug-in assembly (shown) is standard. Other mountings available.

two or three form D

Types HG2 and HG3. Two or three form D Switches enclosed in a single housing. HG2 has 8 or 11-pin octal style plug. An 11-pin base is standard for HG3.

six in-line flat pack

Type HG6F. Six switches mounted in line on printed circuit panel surrounded by single coil. Flat, compact assembly. Over-all dimensions: 3.640" x 3.125" x 1.046". Uses standard 32 or 36 terminal printed circuit socket.



For complete information on CLARE Mercury-Wetted Contact Relays or on the entire CLARE line of superior relays and electronic components address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Limited, P. O. Box 73, 2700 Jane Street, Downsview, Ontario. Cable Address: CLARELAY.

Send for Catalog 201

CLARE RELAYS

FIRST in the Industrial Field

CIRCLE 13 ON READER-SERVICE CARD

New Money Makers for Industry:

KIN TEL CLOSED CIRCUIT TV SYSTEMS

what they are, and what they can can do for you...

What is a KIN TEL Closed Circuit TV system?

The basic closed circuit television system manufactured by KIN TEL consists of a camera, a camera control unit and a monitor (receiver) each connected by cable. The camera can be located at great distances from the monitor, and any combination of cameras and monitors can be used.

The camera is small enough to hold in your hand; rugged enough to operate in 150° F. without a protective housing; sensitive enough to provide excellent pictures of objects observe aircraft landings on the portion of the runway that is not visible from the control tower.

They are being used to transmit visual information quickly and accurately; for remote observation of charts, meters, graphs, schedules, blueprints, photographs, images from microscopes, fingerprints, signatures...the list is almost endless.

For example: E. F. Hutton uses a KIN TEL system to transmit stock market quotations to the offices of the firm's executives. The Los Angeles Depart-

Fourth, the KIN TEL closed circuit TV system is extremely *sensitive*. The light required to read this page is enough for sharp clear pictures, and usable pictures can be provided with less than one-foot candle illumination.

Fifth, KIN TEL TV systems are *easy to install* and *simple to operate*. With no changes in lens iris to make, with no difficult, interacting electrical adjustments required, the only thing the operator has to know is the location of the on-off switch.

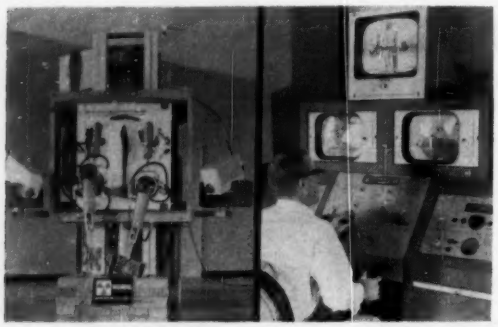
Sixth, a *complete* line of shelf-item system components and a variety of

news

Mobot Makes its Bow

LOS ANGELES, CALIF.—The Mobot Mark I is a combined manipulator and mobile cart, all controllable from a remote location.

Developed and built by Hughes Aircraft Co. for the Sandia Corp., direct contractor for the AEC, the mobile Mobot Mark I can find an item to be tested, carry it into a radiation lock, then "walk" back to its "hot" lab. Mobot can perform a variety of lifting (up to 150 lb



with either arm) inverting and placing operations, comes equipped with 200 ft of cable for wide-ranging maneuverability and can pick up and use auxiliary tools such as wrenches, screwdrivers, hammers and shears for dismantling radioactive material.

Mobot's "pilot" sits safely in another area behind thick concrete where he has no direct view of his "slave" and directs the mobile robot's movements by ITV with pistol-like grip controls that form electronic "reins." A microphone "ear" on Mobot permits the operator to hear its metal fingers grasp an object at the same time he sees the hands clutch it.

William Henry Pugsley

William Henry Pugsley died August 11, 1959, 57 years old, a victim of cancer. For the last twenty-seven years he was a vice president of Hays Corp. in charge of Field Research.

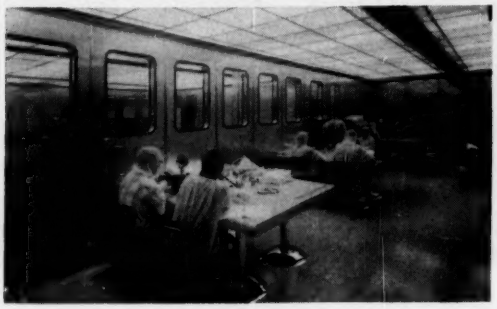
During World War II, in 1943 and 1944, Bill was on loan from the company to the War Production Board as a Dollar-a-Year specialist of the instrument industry.

Bill Pugsley was also well known through his activities and lectures in the ASME and the ISA, and he leaves many friends behind whose esteem he had won by his civic activities.

Mr. Pugsley is survived by his wife Annie White Pugsley, their three children, and two grand children.

White-Room Efficiency Report

BIDDEFORD, MAINE.—Baker Co. which had erected a white room (shown in picture) for Sperry-Farragut Co., Bristol, Tenn., to protect the assembly operations of ball bearings from air contaminants, recently published a report which Armour Research Foundation had been called upon to write on the effectiveness of the measures taken.



With the aid of the ARF particle counter (which counts single particles by using scattered light pulses) it was found that the total concentration of material in the room increased with the amount of activity—i.e., the number of persons present and the type of operation in the room. The highest concentration amounted to 500 particles/liter, and the largest particles were on the order of 32 microns in dia. They were traced to lint from clothing and abrasion products as the main offenders. However, when the room had been cleaned carefully, no more than 330 particles/liter, ranging in size up to 4 microns were found.

DAYSTROM SYSTEMS DIV. has designed new equipment to translate large amounts of process or test data into digital form for transmission over standard telephone circuits. This technique eliminates the requirement for computer equipment at the job site. A large system handling 2000 individual measurements of temperatures, pressures, and flow rates has already been delivered by Daystrom Systems to a major nuclear facility.

IAEA, the International Atomic Energy Agency, recently held a five-day conference in Warsaw, Poland, which was devoted exclusively to the role of ionizing radiation in industrial processing.

REMINGTON RAND has released the new Univac Tape Searchwriter, an integrated system which provides an economical method of searching a magnetic tape file for a desired item and then automatically typing the information or punching it into tape.

RAYTHEON AND BOSTON UNIVERSITY have announced jointly an evening graduate school program leading to the M. A. and Ph. D. degrees in physics. It is believed to be the first industry-sponsored program whereby a graduate degree in physics can be earned after working hours.

FARRINGTON MFG. CO. has received a patent covering two new approaches to character recognition problems which make it possible to recognize a character regardless of where it is positioned as long as it is entirely within the scanning field.

New Money Makers for Industry:

KIN TEL CLOSED CIRCUIT TV SYSTEMS

what they are, and what they can can do for you...

What is a KIN TEL Closed Circuit TV system?

The basic closed circuit television system manufactured by KIN TEL consists of a camera, a camera control unit and a monitor (receiver) each connected by cable. The camera can be located at great distances from the monitor, and any combination of cameras and monitors can be used.

The camera is small enough to hold in your hand; rugged enough to operate in 150° F. without a protective housing; sensitive enough to provide excellent pictures of objects illuminated by only a candle.

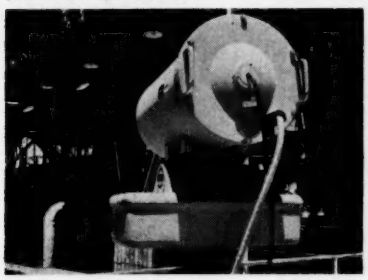
The camera control provides automatic operation. The system is continuously self-adjusting for wide variations in light levels (several thousand to one), and features automatic high definition of bright objects. The only control you have to touch is the on-off switch.

The monitor displays a crisp, clear picture...full 650-line resolution, twice that of the best home TV reception.

How are such systems used?

Today, KIN TEL closed circuit TV systems are performing a number of jobs for *hundreds* of firms, safely, inexpensively, tirelessly.

They are being used to watch operations or events that are tedious, difficult, dangerous, or even impossible for men to watch.



For example: Convair (above), Douglas, Lockheed and Northrop watch rocket tests with KIN TEL systems. U.S. Steel uses one to see inside open hearth furnaces. Westinghouse watches nuclear power reactor tests with one.

They are being used for surveillance.

For example: The San Francisco Naval Shipyard uses one to guard against pilferage.

They are being used for traffic control.

For example: The Alameda Naval Air Station uses a KIN TEL TV system to observe aircraft landings on the portion of the runway that is not visible from the control tower.

They are being used to transmit visual information quickly and accurately; for remote observation of charts, meters, graphs, schedules, blueprints, photographs, images from microscopes, fingerprints, signatures...the list is almost endless.

For example: E. F. Hutton uses a KIN TEL system to transmit stock market quotations to the offices of the firm's executives. The Los Angeles Department of Water and Power uses one for remote viewing of water-level meters. The University of California teaches physics with one.

They are being used for monitoring any operation that normally requires standby personnel.

For example: American Potash and Chemical (above) monitors conveyor line and warehousing operations with a KIN TEL TV system.

Why do these firms choose a KIN TEL system?

For a variety of reasons.

First, *reliability.* KIN TEL TV is designed for continuous duty operation in severe environments. Day in and day out, it keeps working. It's the first choice for ICBM and other missile programs that really depend on TV, that can't chance failure, that can't afford to compromise with reliability.

Second, *picture quality.* KIN TEL TV presents clear, sharp pictures. Full 650-line resolution provides maximum data...essential for *quantitative* observation of complex operations or transmission of printed material.

Third, *automatic operation.* KIN TEL TV is the only closed circuit system that provides entirely automatic, through-the-lens compensation for light-level changes of several thousand to one.

Fourth, the KIN TEL closed circuit TV system is extremely *sensitive.* The light required to read this page is enough for sharp clear pictures, and usable pictures can be provided with less than one-foot candle illumination.

Fifth, KIN TEL TV systems are *easy to install* and *simple to operate.* With no changes in lens iris to make, with no difficult, interacting electrical adjustments required, the only thing the operator has to know is the location of the on-off switch.

Sixth, a *complete* line of shelf-item system components and a variety of cameras and monitors make virtually any application feasible...permit observation of nearly every kind of operation, under all kinds of conditions.

For example, with system components, you can remotely position the camera, remotely select one of several lenses, remotely "zoom" in or out for closeup or wide-angle viewing, operate the camera in extremes of temperature or in explosive or dusty atmospheres, view microscope images. Whatever your viewing problem, KIN TEL probably has a *stock* solution.

Seventh, you don't have to waste your time and money on application engineering. At no obligation to you, KIN TEL's nationwide factory-trained field engineers – thoroughly experienced in optics, environmental requirements, lighting, cabling, human engineering factors, and other installation considerations–can determine whether or not closed circuit TV can be put to profitable use in your intended application.

What can a KIN TEL system do for your business?

It can do what it is doing right now for hundreds of other firms. It can save you time and money...increase efficiency...better your service to clients and customers. To find out how, write direct for catalog 6-103 and the name of your nearest KIN TEL engineering representative.

KIN TEL
A DIVISION OF
COHU
ELECTRONICS, INC.

5725 Kearny Villa Road, P. O. Box 623, San Diego 12, California, BRowning 7-6700

KIN TEL–pioneer and leader in closed circuit television.

CIRCLE 14 ON READER-SERVICE CARD

NO matter how perfect otherwise, the human organism isn't much good without a dependable heart. The same is true of your automatic temperature and pH control instruments.

The "heart" of most such instruments for the past quarter century has been the Eplab Standard Cell. It is a "yardstick" for translation of voltage to temperature or pH. The first American commercial cell of its type, constantly improved by research, it is "as standard as sterling".

Get ACCURATE temperature or pH control with potentiometers and make sure the standard cells are EPLAB.

The Eppley Laboratory, Inc. 2 Sheffield Ave., Newport, R. I.

EPLAB *Standard* CELLS
FOR POTENTIOMETRIC INSTRUMENTS
"As Standard as Sterling"

CIRCLE 15 ON READER-SERVICE CARD

NEWS —CONTINUED

LEEDS & NORTHRUP has received a second Navy contract covering electronic recorders to be installed at the U. S. Naval Air Rocket Test Station at Lake Denmark, Dover, N. J.

At an April ASC meeting, **PERKIN-ELMER** reported results of gas chromatographic analysis of alcohol beverages, showing how very small amounts of congeneric materials are responsible for flavor, odor and hangover effect. Story hit national wire services; result: Perkin-Elmer has been bombarded with requests for whisky extracts and whisky flavors, and congratulated for its fight against alcoholism.

APPALACHIAN GAS MEASUREMENT SHORT COURSE, August, West Virginia University, recorded the largest attendance in nineteen years.

A STRESS MEASUREMENT SYMPOSIUM will be held January 1960 at Arizona State University featuring lectures and exhibit. For more information write to "Strain Gage Readings," 5602 East Monte Rosa, Phoenix, Arizona.

VINCENT E. LYSAGHT, general sales manager of Wilson Mechanical Instrument Div., American Chain & Cable Co., represented the United States as featured speaker at the Third International Work Conference, Sept., Dortmund, Germany. Theme of meeting was "Hardness Testing in Theory and Practice."

Statement of Ownership, etc.

Statement required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933, and July 2, 1946 (Title 39, United States Code, Section 233) showing the Ownership, Management, and Circulation of

INSTRUMENTS & CONTROL SYSTEMS

published monthly at Pontiac, Illinois for October 1, 1959.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Richard Rimbach, 8550 Babcock Blvd., Pittsburgh 37, Pa.; Editor, Milton H. Aronson, 4800 Stanton Avenue, Pittsburgh, Pa., Managing editor, F. D. Marton, 209 Gilkeson Avenue, Pittsburgh, Pa.; Business manager Richard Rimbach, 8550 Babcock Blvd., Pittsburgh 37, Pa.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Richard Rimbach, Sr., Pittsburgh, Pa.; Mrs. Richard Rimbach, Pittsburgh, Pa.; Richard Rimbach, Jr., Pgh., Pa. Mrs. M. F. Behar, New York, N. Y.; Milton Aronson, Pgh., Pa., Martha Rimbach, Pgh., Pa., Gretchen Rimbach, Pgh., Pa.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only).

Richard Rimbach, Publisher

Sworn to and subscribed before me this 1st day of September, 1959.
(SEAL) John T. Roscher,
(My commission expires Feb. 6, 1963)

CIRCLE 76 ON READER-SERVICE CARD

Ten To One

New Fenwal Monitor simultaneously brings 10 remote temperature signals to one central location

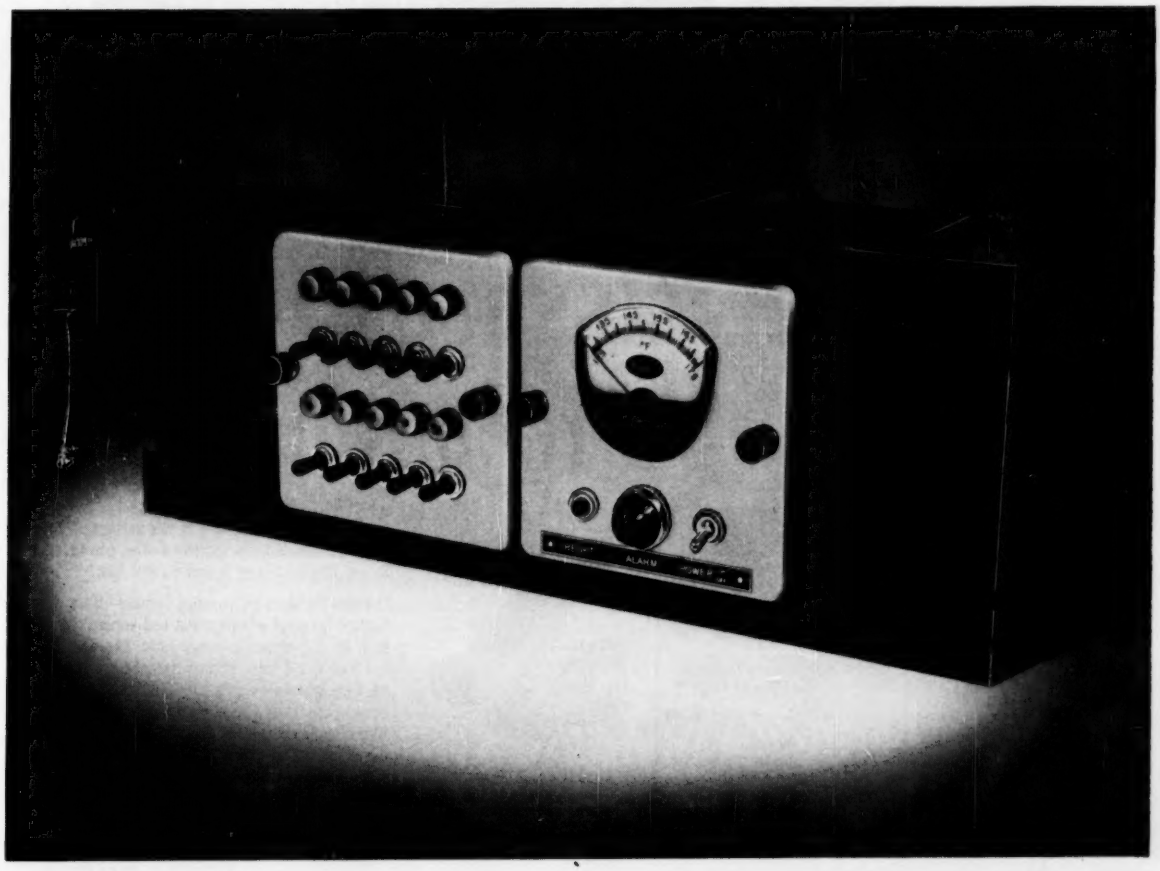
Now there's a monitor that continuously and simultaneously senses all ten of its temperature points. No scanning required . . . no delay in signalling "off" temperatures. *Ten to one it's the positive, fast-acting protection you've needed!*

Monitor's solid-state components are simple, accurate and reliable. Fenwal thermistor sensors install economically with uncompensated electric wiring, have practically limitless life. They change resistance sharply when temperatures change, send strong electrical signals to a rugged, transistorized amplifier. *Wear-free, non-moving parts that combine high performance with low maintenance!*

Fenwal Simultaneous Monitoring Systems are produced by a company with highly integrated design and manufacturing facilities, including its own source of thermistors. And they're repeatedly proving this "better engineering" in all the new commercial jets and many military aircraft. *Small wonder they're dependable on the toughest industrial assignments!*

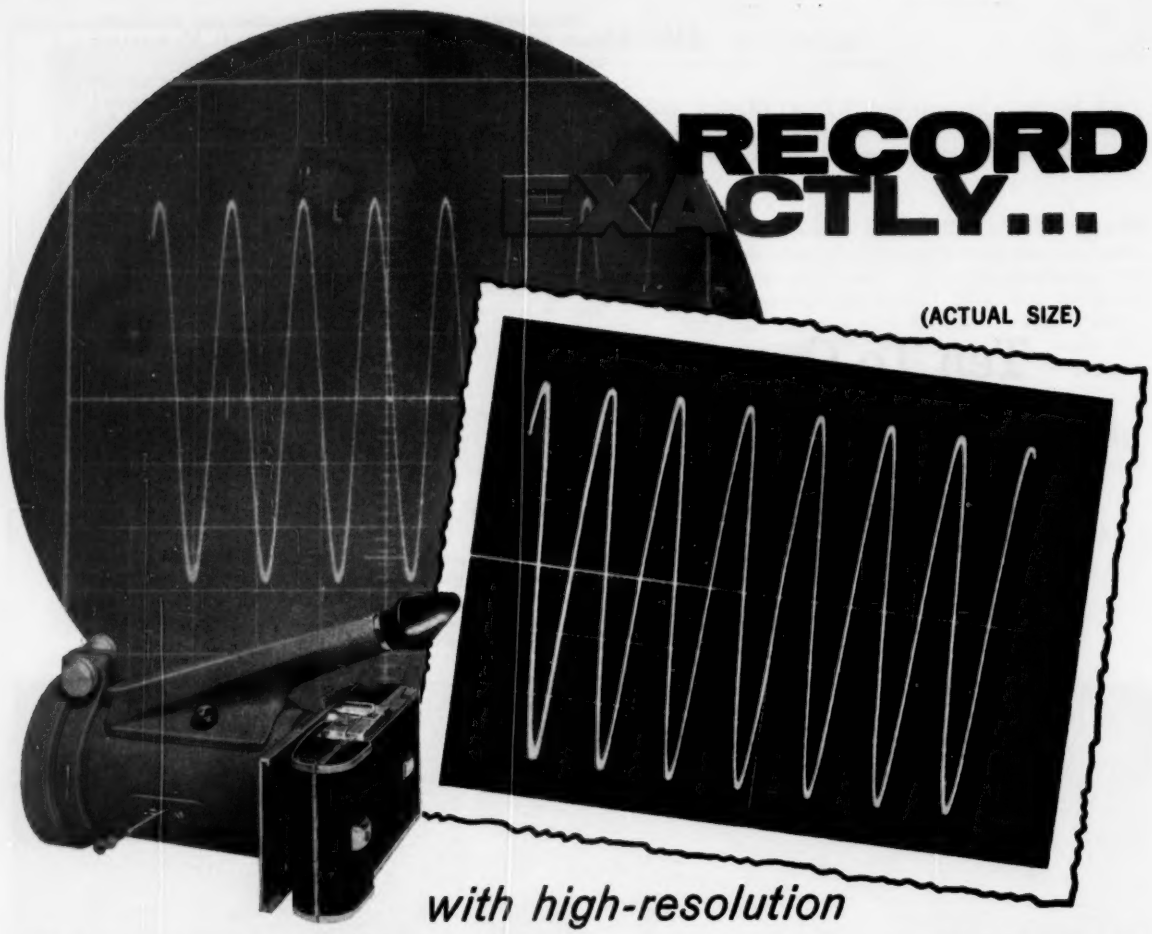
For complete details or complete engineering of your specific temperature monitoring problem, contact a Fenwal Sales Engineer and write for Catalog. Fenwal Incorporated, 3610 Pleasant Street, Ashland, Mass.

Fenwal Continuous 10-point Monitor indicates one or more "off" temperatures by red light or other signal. Operator merely flicks toggle switches to locate trouble. Dial shows each temperature. Temperature Range: 100°F ranges from −25 to 600°F. Voltage rating: 115/230 VAC.



ANOTHER EXAMPLE OF HOW **Fenwal** CONTROLS TEMPERATURE . . . PRECISELY

CIRCLE 16 ON READER-SERVICE CARD



with high-resolution

ACTUAL-SIZE, 60-SECOND PRINTS

DU MONT® 353 record camera

TYPE 299
General-purpose recorder for 5" scopes. Wide variety of backs available.
f/1.9 **$395.00** f/2.8 **$350.00**

TYPE 302
Polaroid-Land camera makes 60-second prints on opaque or transparent films.
f/1.9 **$395.00** f/2.8 **$350.00**

TYPE 321-A
Continuous, or single exposures. Perforated or unperforated 35 mm film. Film speeds to 10,800 in/min.
f/1.5 **$1,395.00** f/2.8 **$1,295.00**

TYPE 339
Polaroid-Land camera for recordings from 3-inch scopes. 1:1 object-to-image ratio.
f/2.8 **$150.00**

TYPE 352
For extremely fast writing rate photography — up to 75 in/usec —on 35 mm film. Automatic operating features enable up to 6 photographs per second.
f/1.5 **$848.00**

In just 60 seconds you can have exact, ready-to-use reproductions of the pattern on the scope screen, exactly the same size, non-reversed, on any standard-type Polaroid Land film*

The new Du Mont 353 Record Camera offers every feature for ease of operation and versatility, such as: 1:1 object-to-image ratio; choice of f/1.9 or f/2.8 lens; sliding detent back for multiple exposures on a single frame; rotatable barrel permitting use of either long or short film dimension; available accessories for use of cut, pack or roll film; easy, fast access to lens and shutter; screen viewing while recording; direct viewing of trace during lens adjustment, to name a few of the many outstanding features.

Price: f/1.9 **$350.00**
f/2.8 **295.00**

*Including Types 46 and 46L positive-transparency negatives.
NOTE: All prices F.O.B., Clifton, N. J., U. S. A.

WRITE FOR COMPLETE CAMERA CATALOG

INSTRUMENT DIVISION, ALLEN B. **DU MONT** LABORATORIES, INC., CLIFTON, N. J., U. S. A.

CIRCLE 17 ON READER-SERVICE CARD

Bristol Dynamaster* Electronic Instruments have proved themselves in thousands of installations. They fully meet today's most exacting standards of accuracy and dependability. They measure almost any variable that can be translated into an electrical quantity (d-c current, d-c voltage, resistance or capacitance). Just a few are: temperature, pH, speed, voltage, smoke density and strain.

Here are some outstanding features that make them ideal for industrial plants, pilot plants, and for research, test, and laboratory use:

1. Continuous standardization—eliminates standardizing mechanism and dry cell—no interruption to control. **But retains precision standard cell for highest accuracy and stability.**

2. Simple design—few moving parts.

3. Easy to use and service—little or no maintenance required.

4. Rugged construction—unaffected by vibration.

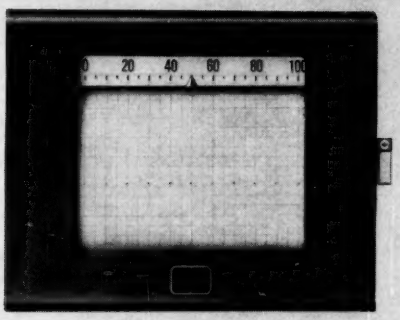
MODELS FOR EVERY PURPOSE. Dynamaster Instruments are now available as:

A. Single-pen, two-pen, and multiple-record (up to 24 points) strip-chart instruments.
B. One- and two-pen round-chart recorders.
C. High-speed recorders (0.4 second).
D. X-Y recorders.
E. Extended range recorders.
F. Adjustable span and zero recorders.
G. Miniature 3-inch strip-chart recorders.
H. Electric controllers in both strip- and round-chart models—all types of control action and as time-program control.
I. Pneumatic controllers in both strip- and round-chart models—all types of control action and time-program control.
J. Instruments for electronic measurement—pneumatic transmission of reading by 3-15 psi signal.
K. Round chart program controllers.
L. Telemetering transmitters.
M. Drum-type precision indicators.
N. Multi-bank recorder—will accept up to 200 separate inputs and record them on 12-inch wide strip chart.
O. Relay-rack mounting models—most models available in case that fits standard 19" relay-rack without modification to instrument or rack, without panel-cutting or masking.

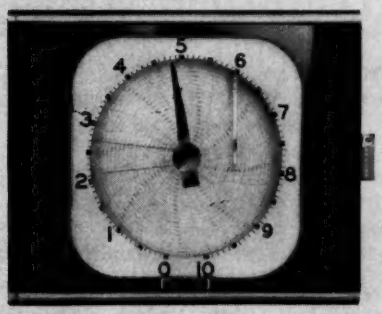
Bristol Dynamaster Potentiometer and Bridge Instruments can be equipped with analog-to-digital encoders of various types for digital readout and computer use. For complete details, write for Bulletins P1245A, P1270, P1271, P1242, and P1282. The Bristol Company, 113 Bristol Road, Waterbury 20, Conn. *T. M. Reg. U. S. Pat. Off.

look to Bristol for the complete line of

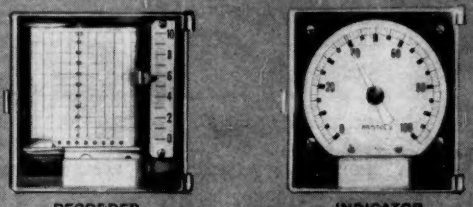
ELECTRONIC POTENTIOMETER and BRIDGE INSTRUMENTS



Dynamaster* Electronic Potentiometer or Bridge—records on 11-inch, 120-foot-long strip chart.



Dynamaster* Electronic Potentiometer or Bridge—records on 12-inch round chart, indicates on extra-large scale.

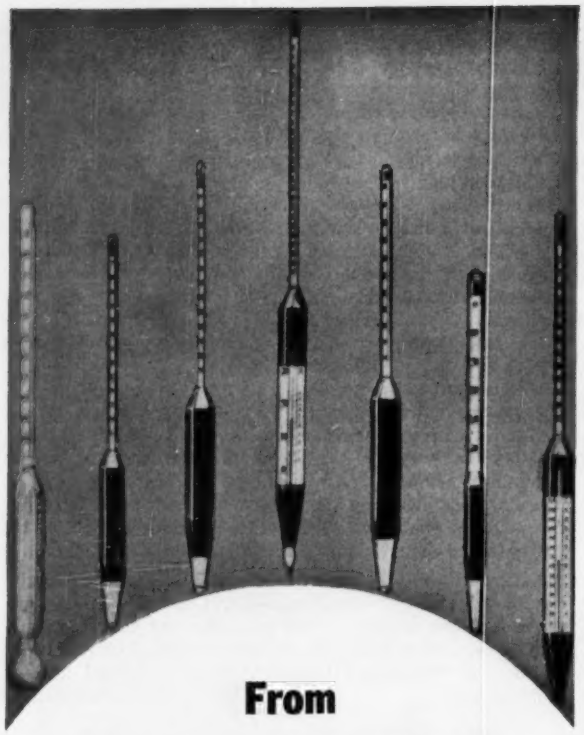


Plug-in Miniature Electronic Dynamaster Potentiometer and Bridge instruments—Only 5" x 5⅛" panel dimensions; ideal for graphic panel instrumentation.

BRISTOL
TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

CIRCLE 18 ON READER-SERVICE CARD



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Expert design and craftsmanship make Moeller Hydrometers the standard in measuring the density of any liquid. The streamlined tip construction, with special alloy ballast, provides a means of quick, accurate readings. All standard density scales. (Specific Gravity, Brix, Twaddle, Balling, etc.) Available in plain form also in combined form, which has built-in thermometer.

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CIRCLE 19 ON READER-SERVICE CARD

stock report

Further information may be obtained from the Research Department, Bache & Co., 36 Wall Street, New York 5, N. Y.

NEW YORK STOCK EXCHANGE

PRICE RANGE FOR 1959 THRU SEPTEMBER 15, 1959

	High	Low	Price As Of 9/15/59
ACF Industries	57	47 5/8	52
Aerojuip Corp.	34 3/4	23 5/8	28 7/8
Allis Chalmers	38 3/4	26 7/8	36
American Chain & Cable	61 3/4	47 3/4	54 1/4 - 55(1)
American Machine & Foundry	100	53 1/2	86 1/4
American Machine & Metals	59 3/4	41	43 1/2
American Optical	53 1/2	38 3/8	46 1/4
American Tel. & Tel.	89	75 1/2	76 1/8
Ampex Corp.	88 1/4	61 1/4	75 3/4
Bausch & Lomb Optical	40 1/2	27	33 1/2
Beckman Instruments	74 3/4	36 1/4	50 1/4
Bell & Howell	74 3/8	53 1/4	56 3/4
Bendix Aviation	89	65 1/4	66
Boeing Airplane	46 1/2	30 1/2	32 1/8
Bullard	24 7/8	16	16 1/2
Bulova Watch	20 5/8	13 1/2	15 1/4
Burroughs	45 3/4	29 5/8	29 3/4
Carborundum	56 3/4	37 3/8	47 1/4
Cincinnati Milling Machine	47 5/8	38 3/4	39 1/4
Clevite	40 3/8	24 3/4	32 7/8
Columbia Broadcasting System	48 3/4	35	40
Consolidated Electrodynamics	45 1/2	33 1/2	34
Consolidated Electronics	53	33 1/2	48
Cornell Dubilier	30 1/2	18	18
Corning Glass	150 1/2	89 3/4	127 1/4
Curtiss Wright	39 1/2	27 1/8	30 3/8
Cutler-Hammer	94 1/4	59 1/2	77
Daystrom	49 3/4	34	37 3/8
Douglas Aircraft	59 3/4	43 1/4	46 1/2
Eastman Kodak	97 3/8	75	89 1/4
Eaton Mfg.	90 3/4	56 1/4	81 1/2
Electric Auto-Lite	55 1/2	36 1/4	47 7/8
Elgin Watch	14	9 3/4	10 1/4
Emerson Electric	69 7/8	48 1/8	56 3/4
Food Machinery & Chemical	55 3/8	40	48 1/2
Gamewell	39 1/4	27	31 3/8
Garrett	50 7/8	38	41 1/8
General Controls	39 1/4	24	28 1/4
General Dynamics	66 1/2	46	46 7/8
General Electric	84 3/4	74 5/8	76 7/8
General Instrument	38 3/8	16 1/2	21 3/4
General Mills	120 1/2	88 1/4	101 1/4
General Precision Equipment	45 1/2	31 1/2	38 3/8
General Railway Signal	39 1/4	32 3/4	34 1/8
General Tel. & Elec.	79	60	68 7/8
General Time	104 1/2	53	74
General Tire & Rubber	83	44 1/8	60 1/4
International Bus. Machines	488	385 1/2	405 1/2
International Tel. & Tel.	45 1/2	28	32 1/8
I-T-E Circuit Breaker	50 1/2	36 5/8	44 1/4
Litton Industries	135 7/8	72 5/8	108 3/4
Lockheed Aircraft	39 3/4	26 1/8	26 1/8
Magnavox	70 3/4	48 1/4	57
Mallory	48 3/4	36 3/8	38 3/4
Minneapolis-Honeywell	150	111 1/2	125
Minnesota Mining & Mfg.	151 1/2	111 1/2	134
Motorola	130	57 1/2	101 1/2
National Acme	63 1/2	50 1/8	50 1/8
National Cash Register	80	57 1/4	58 1/4
Neptune Meter	39 5/8	31	31 1/8
North American Aviation	52 5/8	35 5/8	37 3/8
Northrop Aircraft	44 3/4	27 3/8	27 7/8
Otis Elevator	83	61 1/2	75 3/4
Philco Corp.	36 3/4	21	23 1/2
Radio Corp. of America	71	43 1/8	57 1/2
Raytheon Mfg.	73 7/8	43 1/2	44 5/8
Reliance Electric	63 1/2	42 5/8	58 1/2
Rheem Mfg.	25 3/4	18	20 1/4
Robertshaw Fulton	53 7/8	31 5/8	43 1/4
Royal McBee	24 3/8	16	16 7/8
Sangamo Electric	51 1/2	35	39 3/8
Siegler Corp.	45 1/8	24 1/2	24 5/8
Sperry Rand	28 1/4	21 1/4	23 3/8
Square D	37 1/4	26 7/8	32 1/2
Standard Coil Products	23 3/4	14 3/8	15
Starrett (L.S.)	23 7/8	20	20 3/4
Stewart-Warner	62	42 1/2	53 1/2
Telautograph	13 3/8	9	11 1/2
Texas Instruments	159 1/2	61 1/4	127 1/4
Thompson-Ramo-Wooldridge	70 1/4	52	53 3/4
Tung-Sol Electric	54 1/4	34 1/8	36 1/2
Underwood Corp.	30 7/8	19 1/4	19 3/4
Union Carbide Corp.	150 1/2	120 1/2	134 1/2
United Shoe Machinery	58 3/8	45 5/8	55 1/4
Varian Associates	32 1/2	29 1/2	29 3/4
Wallace & Tiernan	52 7/8	36 1/4	42
Western Union	43 7/8	29 3/4	37 7/8
Westinghouse Air Brake	38 1/2	28 7/8	29 3/8
Westinghouse Electric	98 3/8	70 1/2	88
Worthington Corp.	84 1/2	67 1/2	69

(1) Not traded — Bid and Asked.

AMERICAN STOCK EXCHANGE

PRICE RANGE 1959 THRU SEPTEMBER 15, 1959

	High	Low	Price As Of 9/15/59
American Meter	47 1/4	38	44 1/4
Arc Equipment	29 3/4	21	21 1/4 - 22(1)
Barry Controls "B"	26	13 3/4	17 1/2
Belock Instruments	22 7/8	10 3/8	15 1/4
Benrus Watch	9	5 7/8	6 3/4
Breeze Corp.	9 3/8	6 1/4	6 5/8
Clark Controller	30 3/8	19 5/8	22 1/4
Clarostat Mfg.	10 1/4	4	6 7/8

Continued on page **1474**

ANOTHER NEW LESLIE PRODUCT

ADJUSTABLE PROPORTIONAL BAND Floatless LIQUID LEVEL CONTROL

...with adjustable level ranges up to 0-200"

Here is a new differential pressure-type liquid level control pilot that combines the wide adjustable level ranges in the table shown below with a 2-20" or 7-25" adjustable proportional band.

ADJUSTABLE LEVEL RANGE — INCHES	ADJUSTABLE PROPORTIONAL BAND (INCHES, H_2O)	CONTROL PILOT TYPE
0-40 or 0-87	2-20	LAP
0-30 or 0-91	2-20	LABP
0-200	7-25	LAUP

Maximum Static Pressure — 300 psi

One Knob — Easy Adjustment

A single knob adjustment quickly sets the proportional band where you want it, even while the system is in operation. The liquid level is maintained constantly within that band until you re-set the control pilot for new conditions.

Applications

Leslie-Level-Matic Control Pilots are used in either open or pressurized vessels to control the level of virtually any liquid including water, gasoline, oil and chemical solutions. The new control pilot is particularly useful to maintain constant levels where there are high flow rates through vessels with small cross sectional areas.

Float Cages Eliminated

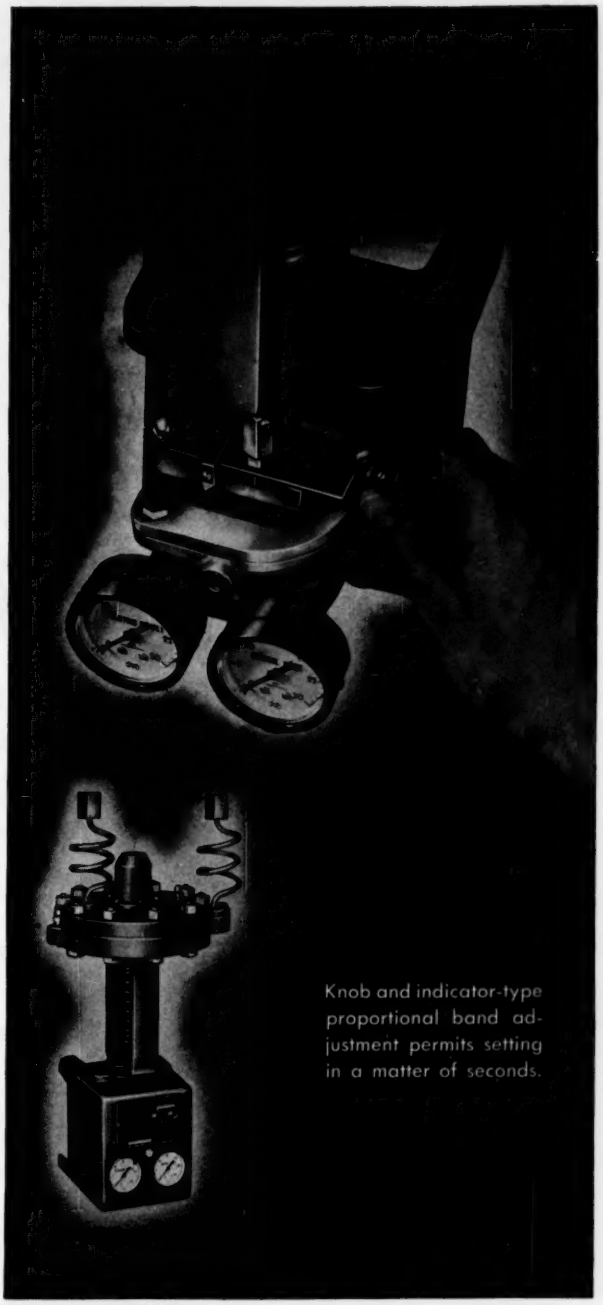
There are no floats or cages needed for Leslie-Level-Matic Control Pilots, and no torque tube seals, stuffing boxes, or thermohydraulic systems. All of the primary control elements are in one place and may be installed with a fraction of the effort and cost required for displacement-type controllers.

Vibration-Proof, Dependable

All of the dependability factors for which Leslie products are so well-known are incorporated in this new control pilot, as well. Rugged, accurate, stable — it is unaffected by normal vibration or turbulence.

More Information

Send for Engineering Data Sheet describing this new Control Pilot and outlining its principle of operation.



Knob and indicator-type proportional band adjustment permits setting in a matter of seconds.

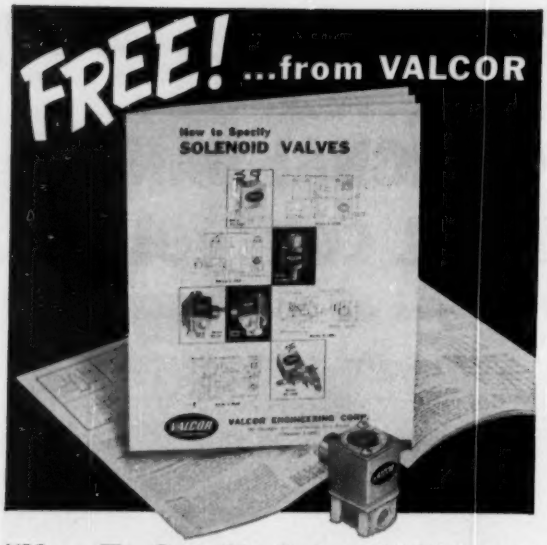
LESLIE

REGULATORS and CONTROLLERS

974

LESLIE CO., 499E Grant Avenue, Lyndhurst, New Jersey

CIRCLE 20 ON READER-SERVICE CARD



"How To Specify Solenoid Valves"

A complete, illustrated guide for calculating flow and pressure drop characteristics... how to determine the most suitable valve configuration... what type of sealing principle is best for you... how to eliminate costly over-specifying. Invaluable to engineering and purchasing personnel.

WRITE TODAY FOR YOUR FREE COPY.

VALCOR SOLENOID VALVES

VALCOR ENGINEERING CORP.

5366 CARNEGIE AVE., KENILWORTH, N. J.
CHESTNUT 5-1665

CIRCLE 21 ON READER-SERVICE CARD

American Stock Exchange: *Continued from page 1472*

Clary Corp.	10 7/8	5 3/4	7 1/8
DuMont Laboratories	9 7/8	6	6 3/4
Dynamics Corp. of America	12 3/4	4 5/8	8 5/8
El-Tronics	2 1/4	1	1 1/2
Electronics Corp. of America	16 7/8	7 7/8	8 1/4
Fairchild Camera & Instrument	205	50 3/4	147
General Transistor	45 3/8	29	34
Globe-Union	27 3/4	20 1/4	22 7/8
Haseltine Corp.	33	24 1/2	25 1/2
International Resistance	22 3/4	7	15 5/8
Lear Inc.	19 1/4	9 1/8	13 1/4
National Research	39 1/2	15 3/8	20 3/8
New Haven Clock	5 3/8	1 1/2	2 3/4
Nuclear Corp. of America	4 1/4	1 3/4	2
Philips Electronics, Inc.	50 1/4	23 1/2	37 1/8
Pneumatic Scale	67	32	43
Servo Corp. of America	43 1/2	14 5/8	23 1/2
Servomechanisms	18 1/4	9	9 1/4
Statham Instruments Inc.	43	23	25 1/2
Victoreen Instrument Co.	19 7/8	6 7/8	12 1/2
Waltham Prec. Instrument Co.	4 3/8	1 1/8	2 5/8

(1) Not traded — Bid and Asked.

OVER THE COUNTER

	Quotation as of 9/15/59 Bid	Asked
Aerovox Corp.	9 3/4	11
Aircraft Radio Corp.	55	--
Argus Corp.	34 1/2	35 1/2
Black Sivalls & Bryson Inc.	22 3/4	23 5/8
Hitel McCullough	20 3/4	21 1/2
Electro Instruments	32	34
Electronics Associates	33	35
Erie Resistor Corp.	8	8 3/4
Fisher Governor Co.	16 1/2	17 3/4
Foxboro Company	66 1/2	69 1/2
Giannini Controls	22 1/2	24 1/4
Hagan Chemicals & Controls	32 1/4	33 1/2
Industro Transistor	6 1/4	6 7/8
Liquidometer Corp.	7 1/2	8 3/4
W. L. Maxson	11	11 3/4
Penn Controls	22 1/4	23 1/4
Speer Carbon, Inc.	19	20 1/2
Sprague Electric	48	51
Taylor Instruments	35 1/4	36
Telecomputing Corp.	9 3/8	10 7/8
Topp Industries	10	11 1/2
Vitro Corp. of America	12	13 1/8

IT'S THE NEW MARK II FROM WESTON:

an advanced new design for the WORLD'S FINEST PORTABLE ANALYZER

Here's an all-new version of the famous WESTON MODEL 980 Volt-Ohm-Milliammeter . . . engineered to offer you

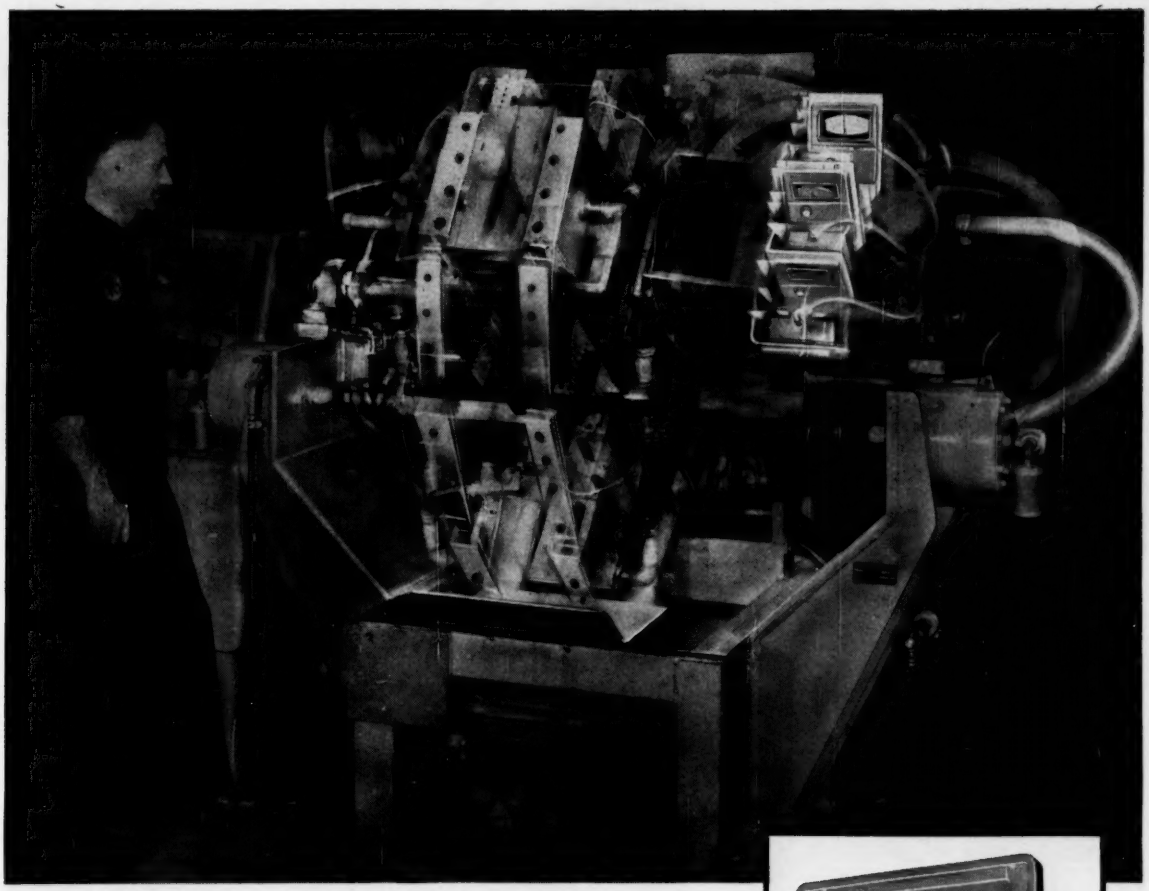
- **INCREASED RANGE.** High-voltage range has been extended to 4000 volts.
- **INCREASED SENSITIVITY.** D-C sensitivity of 20,000 ohms/volt; accuracy within 2% of full scale.
- **IMPROVED SHIELDING.** Cormag® mechanism assures positive magnetic shielding; housing shields against electrostatic interference.
- **GREATER RUGGEDNESS.** Spring-backed jewel movement resists shock, vibration; case is impact-resistant. Ohm-ranges are fuse-protected.
- **SIMPLIFIED CONTROL.** Single dial control for range and function switching.
- **NEW COMPACTNESS.** Size and weight are reduced for maximum convenience and portability.

Order from your local Weston distributor. For information, write to Daystrom-Weston, Sales Division, Newark 12, N. J. *In Canada: Daystrom, Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

WESTON *Instruments*

WORLD LEADER IN MEASUREMENT AND CONTROL

CIRCLE 22 ON READER-SERVICE CARD



A Partlow Model MFS indicating controller is shown in action in this "multiple exposure" shot of a Holo-Core Automatic Molding Machine manufactured by Spo, Inc., Cleveland, Ohio.

The Temperature Control Built to
SHRUG OFF SHOCK
2438 Times a Day

Every working day, the Partlow Temperature Control in this photo takes between 2400 and 2500 solid "roundhouse punches" from the shell-molding machine to which it is attached.

But despite jarring shock and vibration, and a constant barrage of foundry dust, the Partlow goes right on delivering precision control—without letup or breakdown.

Actually, only a control as simple and rock-solid as the Partlow could withstand this kind of punishment! Because only the Partlow contains no hairsprings, or delicate gadgets.

All Partlow thermal elements of the same range are interchangeable *on the job*, too. There's no time lost waiting for your control to come back from the factory. And you get this extra margin of dependability *without loss of accuracy*. Partlow controls are precise to within 1% of scale in any one of 10 ranges from −30° to 1100° F.

If you use or manufacture equipment within this temperature range, there's a Partlow to fit your application exactly . . . and save you money, too. Available in Pneumatic, Electric or Self-Contained Gas types, in recording, indicating or non-indicating models! To field test any Partlow control . . . or to obtain full details write, The Partlow Corporation, New Hartford, N. Y. Dept. IA109.

Export Ad, Auriema, Inc., 85 Broad St. New York 4, N. Y.

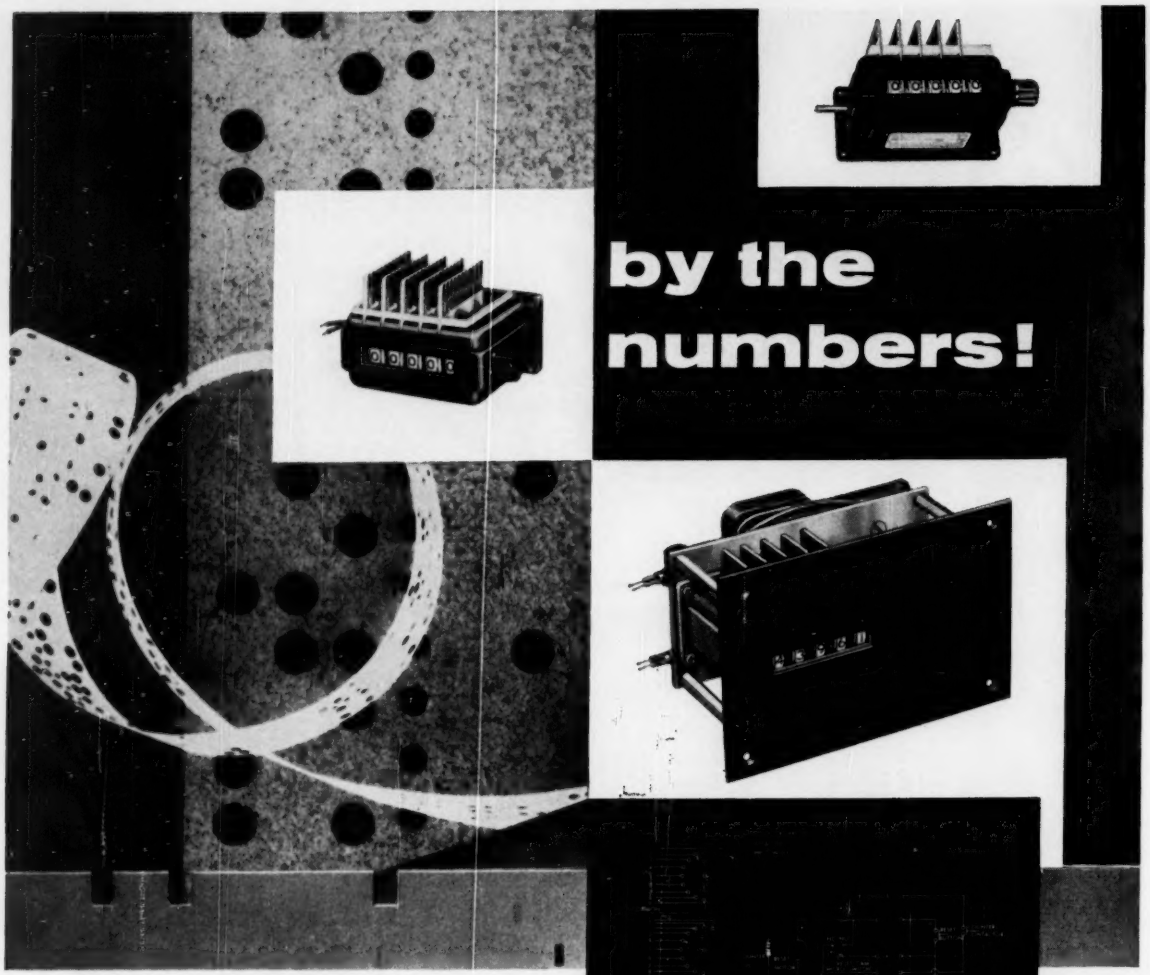
A complete absence of gadgets and superfluous parts, as seen in this open view of the new MFS indicating control, explains the Partlow's unique ability to function accurately even under the most severe operating conditions.

You can pay more but you can't buy better than

PARTLOW

TEMPERATURE CONTROLS

CIRCLE 23 ON READER-SERVICE CARD



Remote Readout Counters Simplify Automatic Data Processing

How these counters work: Data Readout Counters are actuated mechanically by rotation of a shaft or electrically by making and breaking a circuit. Each wheel has a printed circuit, with a contact for each digit. Remote Data Readout Counters are available with manual or electrical reset, and for base or panel mounting. Standard Models are available from stock.

Now . . . Veeder-Root Remote Data Readout Counters can provide a low-cost method of collecting and feeding important information . . . by transmitting counter readings electrically.

Counter readings can be fed directly onto a punched card or tape, and into adding machines or any other data handling devices. The counter can actuate alarms or control machines to predetermined settings. And they can be arranged for automatic reset and recycling. External circuits can be designed to transmit totals in binary code, international code or in digital form.

Remote Data Readout gives you many unusual opportunities to put *Countrol* to work. Automatic processing of machine production, and shaft rotation, remote digital readout, centralized control, simplified automation, and printing and computing applications are just some of the intriguing possibilities available with remote data readout.

Send for Veeder-Root Technical Information . . . Complete specifications on Remote Data Readout Counters will be sent at once; and application assistance is available if desired.

Veeder-Root inc.
HARTFORD 2, CONNECTICUT
"The Name that Counts"

Hartford, Conn. • Greenville, S. C. • Altoona, Pa. • Chicago
New York • Los Angeles • San Francisco • Seattle • St. Louis • Montreal
Offices and Agents in Principal Cities

VRD-57

CIRCLE 24 ON READER-SERVICE CARD

Case Type No. 1279.

Case Type No. 1379 is Alumalife, while similar case Type No. 1079 is Cast Iron.

Case Type No. 1377.

In such cases DURAGAUGES® naturally serve longer

You have a choice of three case materials–Alumalife®, a special aluminum alloy, Cast Iron, rugged and durable, Phenol, tough and rigid plastic–plus the unique "Maxisafe" design when you specify Ashcroft Duragauges.

All three case materials use a chrome plated, die-cast retaining ring to keep out harmful fumes and dirt. Case construction simplifies servicing–the entire system can be easily removed for recalibration or repair.

The "Maxisafe" case provides absolute protection to the viewer, easy and quick access to the tube and movement assembly. An integrally cast solid wall separates the dial from the tube and movement. A safety cover plate on the back is held in position by a knurled knob.

Regardless of your gauge case requirements, there's an Ashcroft Duraguage to do the job. Contact your local Ashcroft Gauge Distributor for complete facts.

Ashcroft Duragauges are available in pressure ranges from 15 psi (or vacuum) minimum to 100,000 psi.

CASE MATERIALS, TYPE NUMBERS, MOUNTING AND SIZES

CASE	TYPE NO.	BACK FLANGE	MOUNTING		CONNECTION		DIAL SIZE
			WALL	FLUSH	LOWER	BACK	
Black Alumalife	1379	Yes	Yes	Yes	Yes	Yes	4½", 6"
Black Cast Iron	1079	Yes	Yes	Yes	Yes	Yes	4½", 6", 8½" 10", 12"
Black Phenol, Turret Design	1279	No	Yes	Yes*	Yes	Yes	4½", 6", 8½"
Black Alumalife**	1377	No	No	Yes	No	Yes	4½", 6", 8½" 10", 12"

**May be flush mounted by using Flush Mounting Ring, Catalog No. 1278.*
***The 10" and 12" dial sizes are made in cast iron only.*

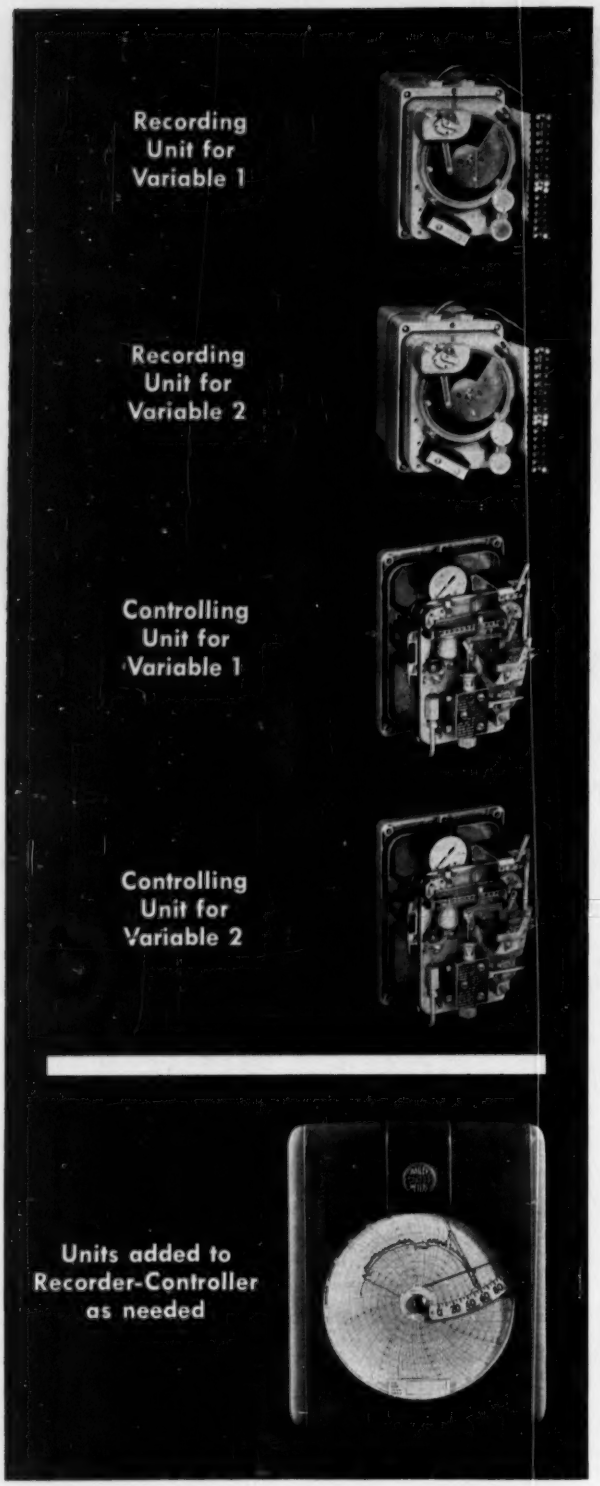
ASHCROFT PRESSURE GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

CIRCLE 25 ON READER-SERVICE CARD


Recording Unit for Variable 1
Recording Unit for Variable 2
Controlling Unit for Variable 1
Controlling Unit for Variable 2
Units added to Recorder-Controller as needed

Bailey Recorder is key to "step-by-step" automation

When you are pioneering a new process and don't know all the answers, complete automation is seldom practical. The first step is to identify your variables and measure them. Nothing does this job better than a Bailey Recorder. One instrument can record any four variables that can be converted to electric *or* pneumatic signals.

Once you get a better understanding of the variables in your process, you will want to add controls and feed back your measurements. Here's where the versatility of the Bailey Recorder comes into play. For the same Bailey instrument you use to record variables is designed to accommodate plug-in control units.

When you use a Bailey Recorder, you can build your instrumentation along with your process. At the start, you use only the plug-in units for recording. Then you add plug-in controls as you see the need for them.

For the complete story of how you can use a Bailey Recorder for step-by-step automation, see your Bailey Engineer.

G-42-1

Instruments and controls for power and process

BAILEY METER COMPANY

1041 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

CIRCLE 26 ON READER-SERVICE CARD

events

October 25-27

Fluid Controls Institute Fall Meeting, Seaview Country Club, Absecon, N. J. For information write R. McCormick, Automatic Switch Co., Florham Park, N. J.

October 26-28

First International Symposium on Gas Lubricated Bearings, Shoreham Hotel, Washington, D.C. For information write Albert Hollingsworth, Franklin Institute Laboratories, Phila. 3, Penna.

October 28-29

Michigan Industrial Electronics Exposition, Detroit Artillery Armory, Detroit, Mich. For information write W. G. Henschen, 830 W. Vernor Highway, Detroit 1, Mich.

October 28-29

6th Annual Computer Applications Symposium, Morrison Hotel, Chicago, Ill., Armour Research Foundation of the Univ. of Ill., Write M. J. Jans, Conf. Secy., Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

October 29-30

5th Annual Electron Devices Meeting, Shoreham Hotel, Washington, D. C., PGED-IRE, Write J. J. Lanigan, Pub. Chrman, Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

November 3-5

1959 Mid American Electronics Conference (MAECON) Midwest Research Institute, Kansas City, Mo., Sponsored by KC Section, IRE. Write Paul C. Constant, Jr., Midwest Research Institute, 425 Volker Blvd., Kansas City 10, Mo.

November 4-6

Sectional Meeting of Society for Applied Spectroscopy & Instrument Exhibition. Hotel New Yorker, N.Y.C. For information write M. F. Wilson, Air Reduction Corp. Research Lab., Murray Hill, N. J.

November 4-6

Eastern Analytical Symposium and Instrument Exhibit, New Yorker Hotel, N.Y.C. For information write Paul Lublin, Sylvania Research Laboratories, Bayside, N.Y.

November 4-6

National Automatic Control Conference, IRE-PGAC, Sheraton-Dallas Hotel, Dallas, Texas. Write Prof. F. W. Tatum, E. E. Dept., Southern Methodist University, Dallas, Texas.

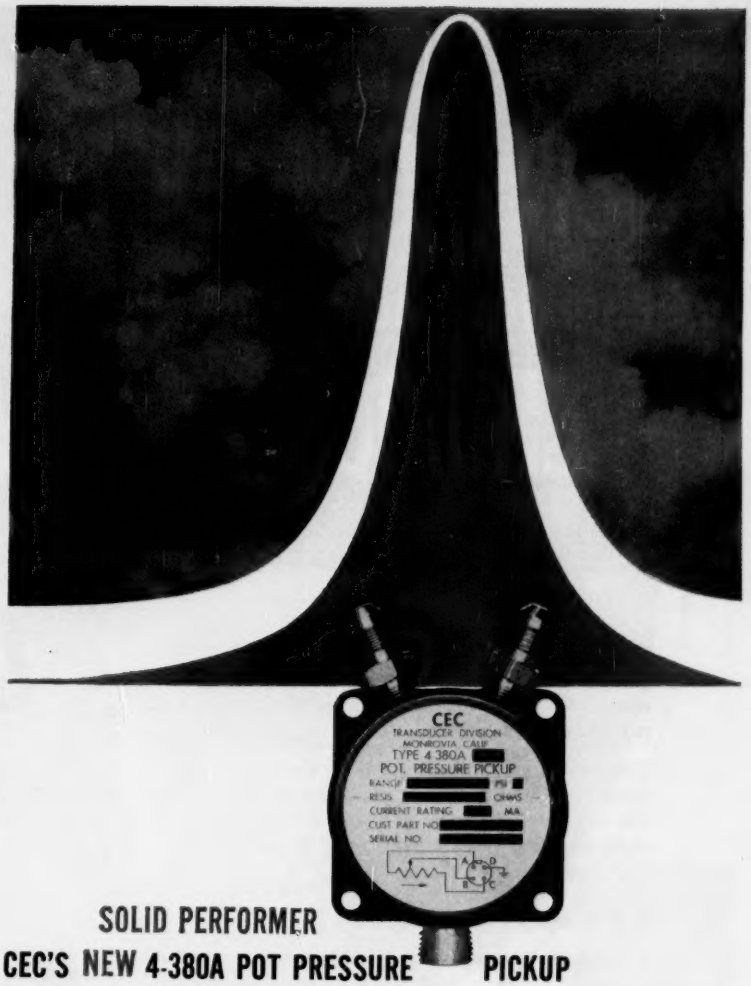
November 5-6

Control Systems Components Conference, held jointly with National Automatic Controls Conference, Sheraton Hotel, Dallas, Texas. For information write Denny Pidhayny, Ramo-Wooldridge, P.O. Box 90534 Airport Station, Los Angeles 45, Calif.

November 5-6

Eighth Annual Instrumentation Conference, on campus of Louisiana

Continued on page 1482



SOLID PERFORMER

CEC'S NEW 4-380A POT PRESSURE PICKUP

Now with a redesigned flexure support system, the 4-380A sets a new standard of performance for low-pressure potentiometer pressure transducers. The 4-380A is unequalled for resistance to shock and vibration. Most pressure ranges are capable of continuous exposure to 25 g vibrations up to 2 KC for periods up to several hours with negligible change in calibration.

Pressure ranges are available from ±1 psi to 100 psi. Absolute, gage, and differential models are offered. Operating over the temperature range from −65° F to +200° F, most pressure ranges exhibit temperature effect of less than one percent. The unique construction of the 4-380A keeps the measured fluid external to the mechanical and electrical system. In absolute models, the internal mechanisms are enclosed within the evacuated chamber. For detailed specifications, call your nearest CEC sales and service office, or write for Bulletin CEC 1604-X17.

Transducer Division CEC

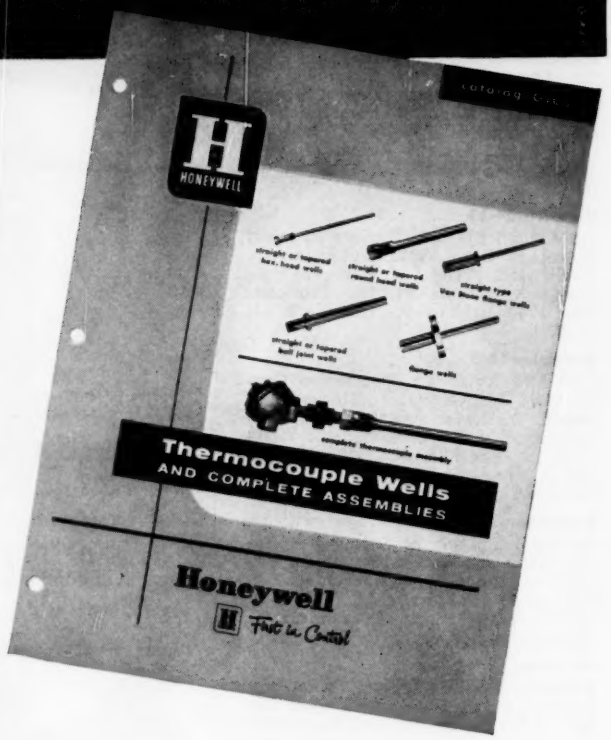
CONSOLIDATED ELECTRODYNAMICS / 360 sierra madre villa, pasadena, california

CIRCLE 27 ON READER-SERVICE CARD

NEW HONEYWELL CATALOG

helps you choose the right

THERMOCOUPLE WELLS



Here's valuable help in the often-perplexing job of picking the right thermocouple wells and assemblies for particular applications.

This new Honeywell catalog brings you a wealth of useful data . . . provides all the information you need to make the right selection every time. Included in the catalog are:

- **Well designs and dimensions**
- **Pressure and temperature ratings**
- **Corrosion data**
- **Thermocouple assembly data**
- **Ordering and pricing information**

Honeywell

First in Control

FILL OUT AND MAIL THE COUPON FOR YOUR COPY—NO OBLIGATION

MINNEAPOLIS-HONEYWELL
Wayne and Windrim Avenues
Philadelphia 44, Pa.

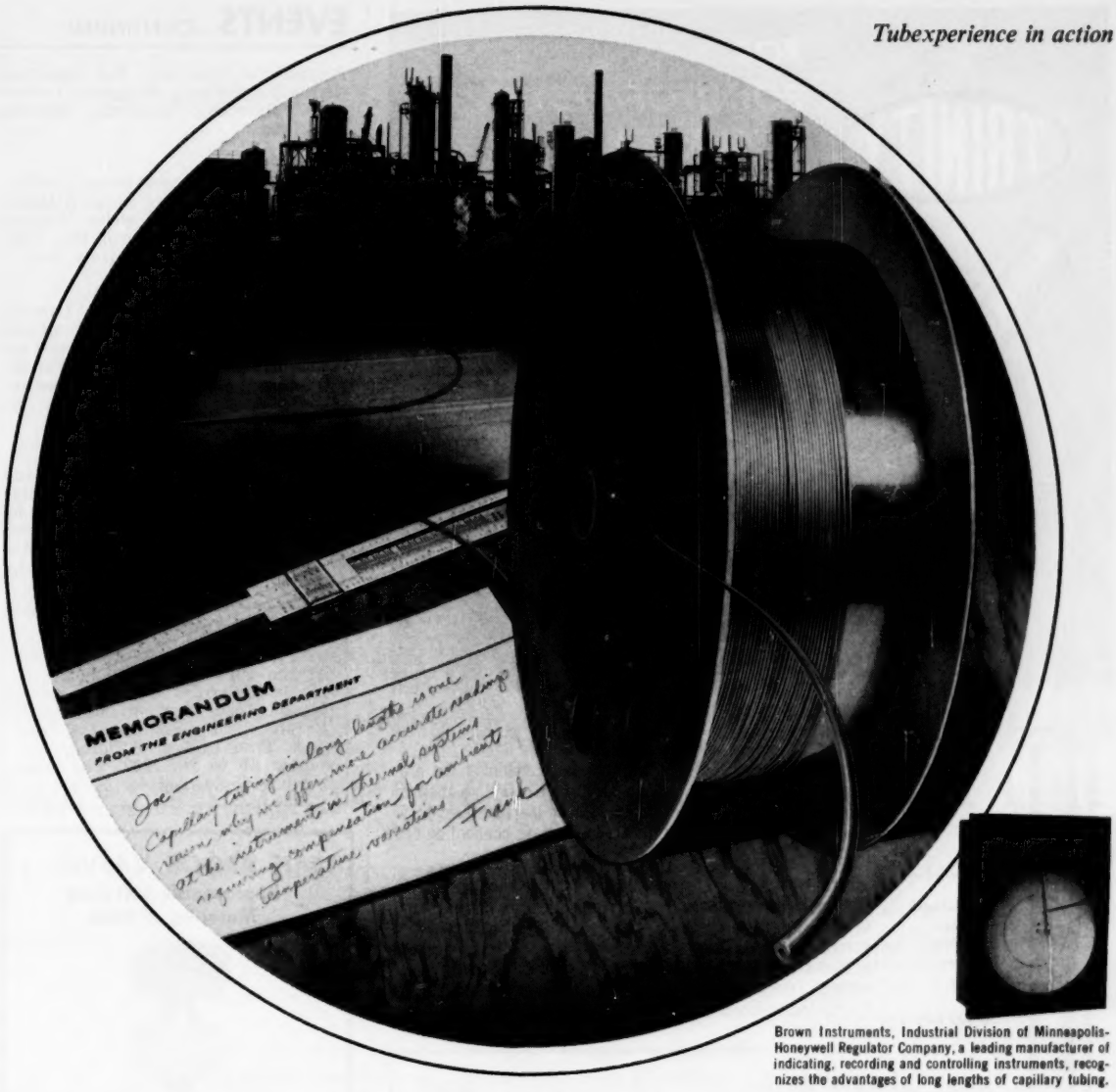
Please send me a copy of the new Thermocouple Wells Catalog G102-1.

Name_____ Title_____

Company_____

Address_____ City_____ Zone_____ State_____

CIRCLE 28 ON READER-SERVICE CARD


MEMORANDUM
FROM THE ENGINEERING DEPARTMENT
Joe—
Capillary tubing in long lengths is one reason why we offer more accurate readings at the instrument in thermal systems requiring compensation for ambient temperature variations
Frank

Brown Instruments, Industrial Division of Minneapolis-Honeywell Regulator Company, a leading manufacturer of indicating, recording and controlling instruments, recognizes the advantages of long lengths of capillary tubing.

Up to 3000 ft. of capillary tubing in 1 piece

Seldom does an instrument installation require 3000 ft. of capillary tubing in one piece—the quantity is normally much less. But the advantages of long lengths are numerous. A simple long length of capillary tubing has greater ID uniformity than a series of short lengths separately produced. This permits more accurate transmission of data between instruments controlling a process. Instrument manufacturers find that long lengths reduce scrap. They also lessen the number of setups required and the costs of inserting the capillary tubing in flexible metallic protective sheathing.

Superior has spent years in the development of manufacturing processes and quality control procedures for the production of close tolerance tubing. ODs range up to $\frac{3}{16}$ in., IDs from .004 through .040 in. Analyses include Types 304, 316, 321, 347 and 446 stainless; also Monel, Inconel, nickel and carbon steel alloys. Data Memorandum No. 11 gives complete details—let us send you a copy. Superior Tube Company, 1968 Germantown Ave., Norristown, Pa.

Monel and Inconel are registered trademarks of International Nickel Co.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to $\frac{3}{8}$ in. OD—certain analyses in light walls up to $2\frac{1}{2}$ in. OD

West Coast: Pacific Tube Company, Los Angeles, California • FIRST STEEL TUBE MILL IN THE WEST

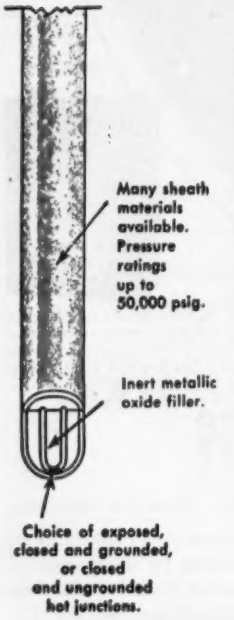
CIRCLE 29 ON READER-SERVICE CARD

FOR POINT-OF-READING ACCURACY...

TRINITY

Trinox

metal-sheathed thermocouples designed and built for maximum accuracy, response speed, and dependability.


Many sheath materials available. Pressure ratings up to 50,000 psig.
Inert metallic oxide filler.
Choice of exposed, closed and grounded, or closed and ungrounded hot junctions.

Trinox units offer the user a single unit combining the protection of a thermowell and the accuracy of a fine thermocouple. The thermocouple is encased in an inert metallic oxide within a metal sheath with the proper process connection and junction.

Inherent small size of Trinox lends itself to miniaturization. Extremely fast response permits more accurate readings and control in critical systems. Trinox units may be formed into practically any configuration to meet requirements, and are available in .040", 1/16", 1/8", 3/16", 1/4", 5/16" diameters. Trinox is also available from stock in random lengths for customer fabrication.

FOR MULTI-POINT ASSEMBLIES

Single process connection can accommodate a number of Trinox units with hot junctions at various points as required.

WRITE FOR COMPLETE DETAILS...

On Trinity Thermowells for all applications, Thermocouples and Trinox Thermocouples.

TRINITY THERMOWELLS • THERMOCOUPLES

Dynamic Dryers, Heat-Les and Heat-reactivated.

TRINITY EQUIPMENT CORPORATION, CORTLAND, NEW YORK

CIRCLE 30 ON READER-SERVICE CARD

EVENTS—CONTINUED

Polytechnic Institute. For information write Stewart Baggarly, Louisiana Polytechnic Institute, Ruston, Louisiana.

November 9-11

Fourth IRE Instrumentation Conference, Atlanta Biltmore Hotel, Atlanta, Ga. For information write William Bradley, Scientific Atlanta, Inc., 2162 Piedmont Rd., N.E., Atlanta 9, Ga.

November 10-15

International Exhibition of Laboratory, Measurement and Automation Techniques in Chemistry, Swiss Fair Buildings, Basle, Switzerland. For information write Emil M. Bammater, Swiss Industries Fair, Basle 21, Switzerland.

November 16-19

5th Conference on Magnetism and Magnetic Materials, Sheraton-Cadillac Hotel, Detroit, Mich., Sponsored by Univ. of Mich., IRE, Am. Phys. Soc., ONR, AIEE and Met. Soc of AIME. Write D. M. Grimes, Dept. of E. E., Univ. of Mich., Ann Arbor, Mich.

EXPOSITION POSTPONED

PITTSBURGH—Management for the Fifth International Automation Congress and Exposition has announced postponement of the show scheduled for the New York Trade Show Building, November 16 to 20, 1959. The show will be rescheduled for 1961.

LEAK PROOF VALVES...

Replaceable Soft Seat Metering or Flow

HI-VACUUM TO 6,000 PSI

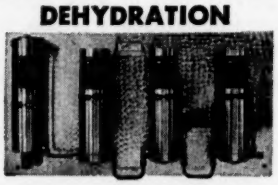
PNEUMATIC HYDRAULIC

ANGLE—GLOBE—THREE PORT—MANIFOLD

ROBBINS Aviation, Inc.

2350 E. 38th St.—Los Angeles 58, Calif.

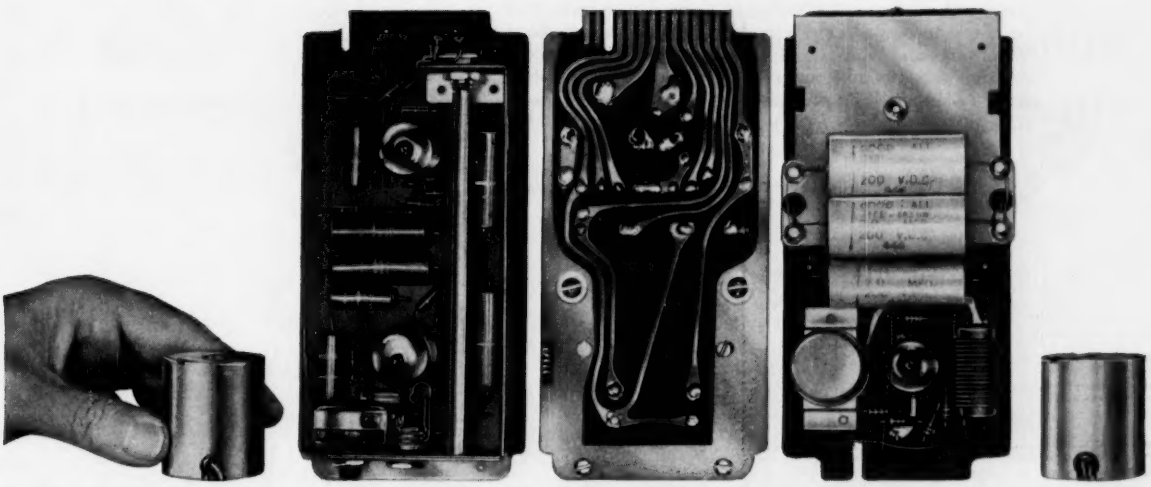
DEHYDRATION



Remove moisture & oil vapor from gases with working pressures up to 12,000 PSI; dew points -100°F.

CIRCLE 73 ON READER-SERVICE CARD

CONTROL SYSTEMS RELIABILITY?



SWARTWOUT SIMPLICITY PUTS IT ON THE LINE

ONLY FIVE BASIC ELEMENTS IN THE WHOLE AUTRONIC® LOOP!

Here you have it: all the electronic components of a typical, complete AutroniC control loop. On the left, a differential transformer to provide the process signal; on the right, another for the set-point signal. In the middle, the three neat printed-circuit cards that handle all basic controller functions. The AutroniC System is essentially that simple. Deliberately so.

It was Swartwout, you know, who started this whole business of electronic process control. And Swartwout it is, who now leads the field with the most extensive line of equipment . . . the broadest breadth of experience . . . and the proudest record of successful installations.

Experience of our customers has confirmed our belief that simplicity is the best single determinant of reliability. So, no extra gimcracks or gadgets; the AutroniC System is as lean as an Olympic miler. Premium components keep it in top condition . . . even under year-in and year-out use.

Before you put down your dollars for an electronic control system, give Swartwout AutroniC Control a good looking over. You'll like what you see. Try Bulletin A-913 for a starter.

SWARTWOUT

. . . world leader in electronic process instrumentation

THE SWARTWOUT COMPANY
18511 EUCLID AVENUE
CLEVELAND 12, OHIO

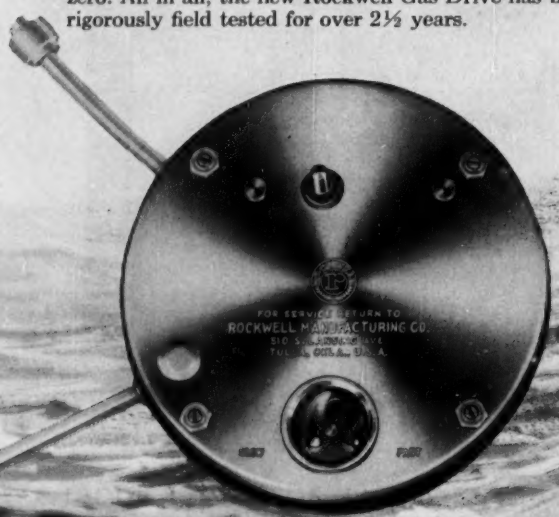
S.A. 2062

CIRCLE 32 ON READER-SERVICE CARD

← CIRCLE 31 ON READER-SERVICE CARD

The only chart drive that

During Hurricane "Flossy" all oil production on the Gulf Coast closed down because it was impossible to get out and wind the intermitters. A prototype of the newly announced Rockwell Gas Drive ran constantly through this emergency on a Pure Oil well, off the coast of Louisiana. A number of these drives have also been in successful service in the production regions of Wyoming and Canada operating through two cold weather seasons at temperatures down to −40° below zero. All in all, the new Rockwell Gas Drive has been rigorously field tested for over 2½ years.



Rockwell Gas Drive powers this typical intermitter

FEATURES

- **Powered by gas or air—no winding**
- **Built right into a standard Rockwell chart drive case**
- **Adapts to fit practically any instrument without cutting**
- **Uses only 4 cubic feet of gas in 24 hours**
- **Operating pressure range 15-25 psi**

withstood Hurricane "Flossy"

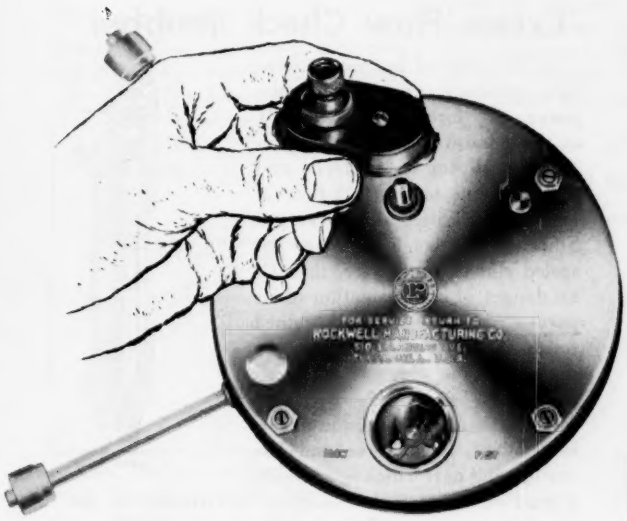
THE NEW ROCKWELL GAS DRIVE

A gas or air powered chart drive for all kinds of recording instruments—completely self-contained, self-starting.

Let's hope you will never need a chart drive that will run throughout a hurricane, but right now you can use the new Rockwell Gas Drive with profit to power remotely located instruments. You can forget the costly chore of periodic winding, for this drive is completely self-powered by the gas (or air) in the flowing stream.

The Rockwell Gas Drive is economical to run—it consumes only 4 cubic feet of gas every day. It's safe, too, for there is no venting problem. And it is built right into the case of a standard Rockwell chart drive and has all the interchangeability features of the spring wound design. It can be neatly fitted into practically any make intermitter, production timing instrument or recorder by using furnished adaptors for position and height. Speed changing turrets, which snap on to the main arbor, provide the utmost versatility in rotation rates. So with a stock of standard Rockwell Gas Drives, plus a selection of economical turrets, you can serve all your instrument needs.

Get full facts by writing Rockwell Manufacturing Company, Instrument Division, Pittsburgh 8, Pa.



The turret on top does the trick.

See how easy it is to convert a Rockwell Gas Drive to any of 10 different rotation rates.

The main arbor on this drive rotates once every 24 hours. Speed changing turrets are available to give 2-hour, 3-hour, 4-hour, 6-hour, 12-hour, 48-hour, 72-hour, 7-day, and 8-day rotation. No special tools or skills are required to convert to different rotation rates; the turrets snap into place.

GAS DRIVES, CHART DRIVES

another fine product by

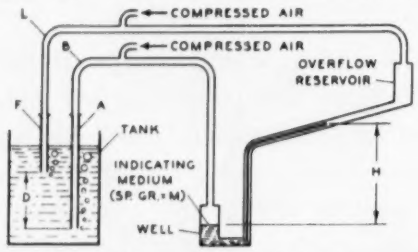
ROCKWELL

CIRCLE 33 ON READER-SERVICE CARD

briefs

Determining Specific Gravity Hydrostatically

Two separate compressed air supplies (controlled by flowmeters) introduce air into both static tubes. The distance between the static tubes, "D," is constant—and predetermined. Under these conditions, the manometer's indicating liquid (of known and selected specific gravity) will be displaced proportionately to a height, "H," which will remain stationary, so long



as both the specific gravity of the liquid tested and the flow of compressed air remain unchanged. Since the flow of the compressed air can be held constant, the displacement of the indicating liquid will change only when the specific gravity of the tested liquid changes . . . The displacement of the indicating liquid can be determined from the following formula:

$$H = \frac{D \times G}{M} - K \times \frac{D \times G}{M}$$

$$\text{or } G = \frac{H \times M}{D - (K \times D)}$$

(H= displacement of indicating medium, in inches; D= head of liquid from open end of high static tube to open end of low static tube, in inches; G= specific gravity of liquid in tank or vessel—units Sp. G.; M= specific gravity of indicating liquid in manometer —units Sp. G.; K = a constant—mathematically computed well drop, in inches.) Since values "M", "D" and "K" are definitely under control and are made constant, the value "H" can directly indicate the specific gravity . . . (*From new 88-page "Handbook of Hydrostatic Instruments," Petrometer Corp., 43-22 Tenth St., Long Island City 1, N. Y.*)

FOR THIS LITERATURE CIRCLE 154 ON READER-SERVICE CARD

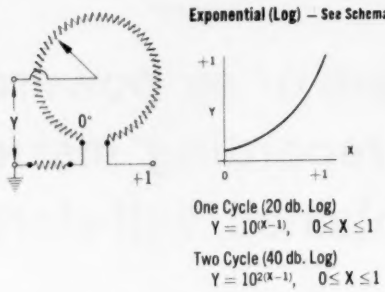
Basic Weight Scales

These scales indicate the weight, in pounds per ream, directly from the weight of a single sheet of paper, without any calculation. A 20 inch long pointer provides very fine sensitivity. Exceptionally fine, clear reading is easy with a dial that is 22 inches in length and located at eye level . . . (*From new 4-page Bulletin 321-BW, Thwing-Albert Instrument Co., Penn St., at Pulaski Ave., Phila. 44, Pa.*)

FOR THIS LITERATURE CIRCLE 155 ON READER-SERVICE CARD

Non-Linear Potentiometers

Precision potentiometer specifications call for voltage or resistance functions which do not maintain a linear output proportional to shaft rotation. Potentiometers of this type are termed non-linear, or functional. They are designed with special resistance elements to

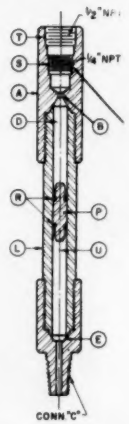


produce non-linear curves of infinite variety. Non-linear functions can be developed in all Spectrol models. Many of the more common curves are standardized . . . There are two fundamental categories of non-linear applications—voltage and resistance functions. Because the two are so closely related, differences should be noted . . . A potentiometer is basically a voltage pick-off device. With a voltage applied across the end terminals, a varying potential appears at the wiper proportional to the shaft rotation . . . A mathematical formula that defines every point along the entire curve, including end points, is desirable. Terms of the formula must be identified and given values. Examples of this type are trigonometric functions, algebraic, and exponential equations . . . (*From new 80-page Catalog 202, Spectrol Electronics Corp., 1704 South Del Mar Ave., San Gabriel, Calif.*)

FOR THIS LITERATURE CIRCLE 156 ON READER-SERVICE CARD

Excess Flow Check Snubber

In the event of instrument rupture, pressure upstream of the piston (U) forces the piston (P) to the opposite end of the cylinder (L), closing the port (B) and thus prevents loss of product, at pressures as high as 30,000 psi. Since the snubber is built into the sealed end of the device, there is no danger of contamination of its porous material with entrained solids suspensions which may be present in the pressure actuating medium.



Compact and simple, the device is efficient, inexpensive and has one moving part which moves only a fraction of an inch, resulting in virtually no mechanical wear . . . (*From new 2-page leaflet, Chemiquip Co., 36 East 10th St., New York 3, N. Y.*)

FOR THIS LITERATURE CIRCLE 157 ON READER-SERVICE CARD

Engineered Dehydration in Pneumatic Systems

Moisture and calibrated springs ■
Clean air on low flow ●
Refrigifilter—new "package" ◆
Sponge explains dew point ○

■ What price calibration?

Above you see the apparent villain of a mechanical tragedy—with a plot all too familiar to industry. The picture shows two calibrated springs, true heroes of a pneumatic control system until they ran afoul of the real villains – moisture and sludge in the compressed air lines. Result? A fine set of precision springs ruined. Worse, failure of a well-engineered pneumatic control set-up with consequent malfunction of operating equipment.

Prevention could have been simple. A Hankison Condensifilter used to filter and dehydrate compressed air downstream of the receiver would have saved the springs, eliminated downtime and costly repairs. The owners of these springs are now using Hankison Condensifilters – a fact that fellow instrument engineers would do well to remember. Look into Bulletin 4158 describing Condensifilters.

● Not a trace

What low-cost desiccant dehydrators are designed to provide clean, vapor-free air or gas to pneumatic equipment

CM-1 Dehydrafilter. Cutaways show air inlet and outlet at top, desiccant and cartridge at bottom.

on dead end or low-flow service? Answer: Hankison Dehydrafilters.

With water adsorption capacity at 28%, and obtaining dew points as low as −67°F, Dehydrafilters effectively eliminate costly steam or electric tracing of the air lines. Several models are available. Capacities of 1 SCFM at 100 PSIG to 25 SCFM at 6000 PSIG can be accommodated.

◆ What's the point?

Dew Point, naturally! You can get a dew point as low as −30°F with the new Hankison Refrigifilter. It's the

compact, economical piece of equipment you need to prevent costly instrument and control foul-up. Combining the functions of a heat exchanger, condenser, separator, filter, and trap, the Refrigifilter requires *no on-site cooling water, and eliminates problems caused by ambient temperature variance.* Pneumatic systems are provided micro-clean, dehydrated, oil-free compressed air—systems are freed of the rust and sludge hazard that causes downtime and sometimes results in the complete failure or replacement of equipment. A unique heat exchanger pre-cools incoming air, and reheats the outgoing dehydrated air to reduce relative humidity and prevent sweating on the lines. *The equivalent of 9000 BTU/hr. of heat transfer is effected with refrigeration equipment rated for a maximum output of 4000 BTU/hr.* Condensate—oil and moisture vapor as well as entrained liquids—is discharged through the integral Mag-Pneu-Power Trap. Solid contaminants are removed by the specially designed filter cartridge. Maximum operating pressure of the unit is 300 PSIG (providing a −30°F atmospheric dew point), and pressure drop across the unit does not exceed 4 PSIG.

New Bulletin F-100 will be sent promptly upon request.

○ A Sponger

Are you sure you use the terms "dew point" and "relative humidity" correctly? If there's any doubt, write for your copy of "THE DEW POINT STORY." A simple bath sponge analogy clarifies these terms in simple, easy-to-read language.

HANKISON CORPORATION, COLLEGE & PIKE, CANONSBURG, PA.

There's something here that interests me. Please send me more information about

- ☐ Hankison Condensifilters
- ☐ Dehydrafilters
- ☐ Refrigifilters
- ☐ Dew Point

NAME _____ TITLE _____

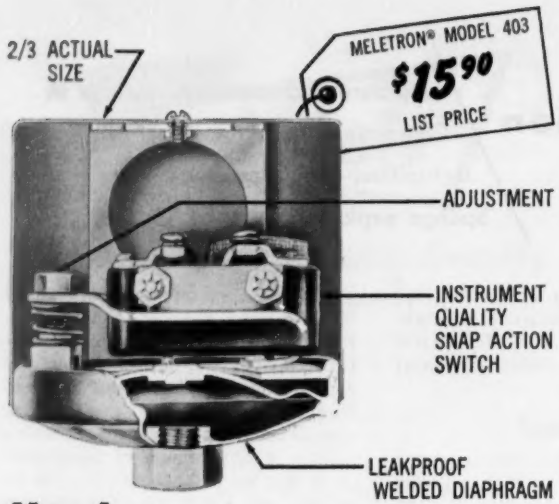
COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

Hankison

CIRCLE 34 ON READER-SERVICE CARD



Here's the Simplest Diaphragm Pressure Switch

WE BUILD IN	WE DON'T USE
EXTREME ACCURACY and DEPENDABILITY maintained during operating life due to direct acting design	LINKAGES & BEARINGS which, as they wear, make the setting of the pressure switch drift.
OPERATION IN ANY POSITION which saves the installation costs encountered in mounting a switch that uses liquid switching elements	LIQUID SWITCHING ELEMENTS which make the switch difficult to mount and very critical to vibration.
IMMUNITY TO VIBRATION you can mount the switch directly on your vibrating or moving equipment.	ACCORDION BELLOWS which make the pressure switch sensitive to vibration.

ASK FOR NEW CATALOG 9-PS FREE

PRESSURE SWITCH DIVISION

Barksdale valves

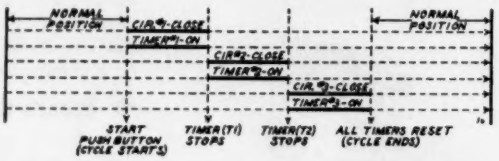
5125 Alcoa Avenue, Los Angeles 58, California

CIRCLE 35 ON READER-SERVICE CARD

BRIEFS—CONTINUED

Reset Timers

Three Load Circuits.—Each circuit closes and opens in sequency: (1) Start Push Button momentarily closed, timer (T1) starts, circuit No. 1 closes. (2) At end of preselected time period, circuit No. 1 opens, timer (T1) stops, (T2) starts and load circut No. 2 closes. (3) At end of preset time interval circuit No. 2

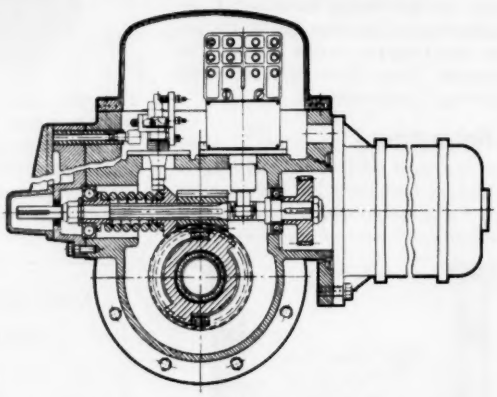


opens, timer (T2) stops, timer (T3) starts and circuit No. 3 closes. (4) At end of preset time interval circuit No. 3 opens, timer (T3) stops and all timers reset. (5) To reset before completion of time interval, momentarily depress stop push button. (6) If power fails, during timer operation, timer insantly resets and all circuits open . . . (*From 73-page binder, Lumenite Electronic Co., 407 South Dearborn St., Chicago 5, Ill.*)

FOR THIS LITERATURE CIRCLE 158 ON READER-SERVICE CARD

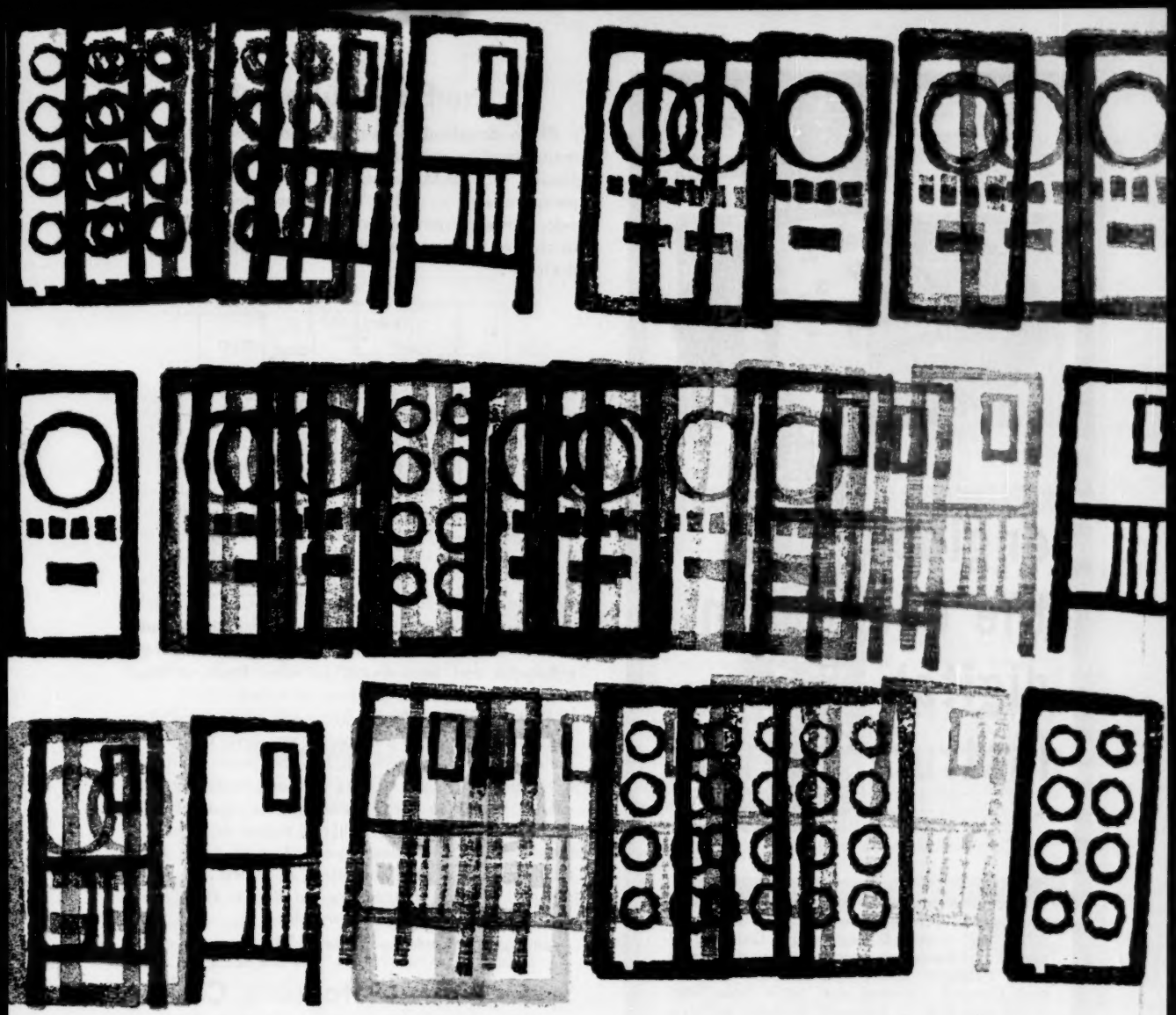
LimiTorque Valve Control

LimiTorque is an efficient, sensitive, automatic, power actuated device for controlling all types of valves, sluice gates and shipboard water tight doors. In the event of a power failure, LimiTorque can always be manually operated through a powerful hand-



wheel control . . . LimiTorque may be fitted to any size valve in almost any position or location and can readily be adapted to existing equipment. LimiTorque can be actuated by a wide range of power sources including electricity, hydraulic pressure, air or high pressure natural gas. Gas and oil pipelines utilize VHF Microwaves as a means of initiating operations of remote valves . . . (*From new 30-page Catalog L-550, Philadelphia Gear Corp., Erie Ave. & G St., Phila. 34, Pa.*)

FOR THIS LITERATURE CIRCLE 159 ON READER-SERVICE CARD

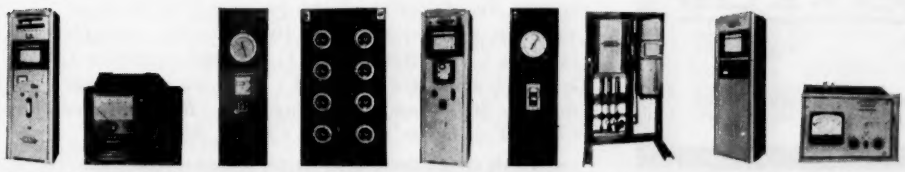


MSA CAN DO: COMPLETE LINE

instrumentation for process stream analysis

MSA can do, does, and will provide for you: complete line instrumentation for process stream analysis. The accurate, reliable kind. Standard or special. Simple or sophisticated. Instruments, sample systems, and accessories.

Please state your particular sampling problem —as well as the MSA Instrument of interest— when writing for descriptive literature.



M-S-A® LIRA® Infrared Analyzer Model 200 | M-S-A® LIRA® Infrared Analyzer Model 300 | M-S-A® Inert Gas Analyzer | M-S-A® Combustible Gas Analyzer | M-S-A® Thermatron Analyzer | M-S-A® Oxygen Indicator | M-S-A® Water Vapor Recorder | M-S-A® BillionAire® Analyzer | M-S-A® Process Refractometer

*Trademark

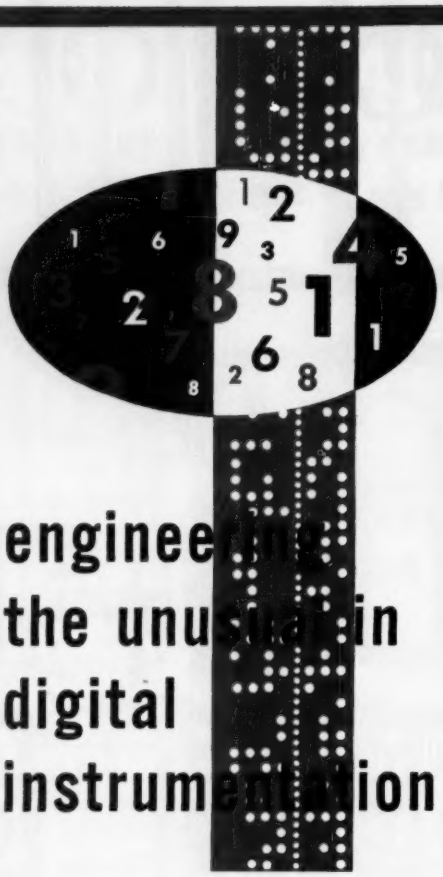
MSA®

INSTRUMENT DIVISION

Mine Safety Appliances Company

Pittsburgh 8, Pennsylvania

CIRCLE 36 ON READER-SERVICE CARD



engineering the unusual in digital instrumentation

Peak engineering loads, tight delivery schedules, shortages of personnel . . . all place an added strain on overtaxed engineering facilities. If digital equipment engineering is part of this load, Franklin Electronics' Communications and Control Division can serve you best. Franklin's C & C Division, working in close cooperation with your engineering staff, designs and develops digital instruments and data systems to your specifications.

Whether the need is for a complete data acquisition and reduction system, a language translator, or a simple digitizer, you'll be pleased with how the C & C Division can ease your engineering load. But most of all, you'll be pleased with the final product . . . delivered on time . . . on a guaranteed performance basis.

Bulletin CC-220 describes the work of the C & C Division, its facilities, some of the equipment it has developed in the past . . . and how it can assist you now. Write for a copy. There's no obligation, of course.

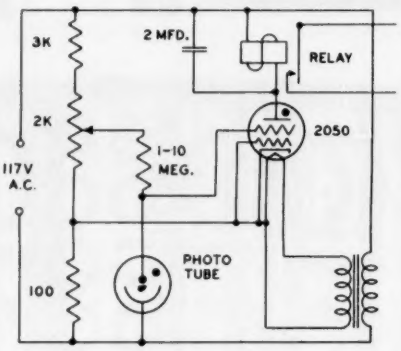
FRANKLIN electronics, inc.

COMMUNICATIONS AND CONTROL DIVISION
VAN NUYS, CALIFORNIA

CIRCLE 37 ON READER-SERVICE CARD

Phototubes

Photo electric devices divide themselves into three major families, with several subdivisions within each family: (1) photo emissive, (2) photo resistive, (3) photo voltaic . . . It has become accepted practice to refer to the photo emissive devices as phototubes and to reserve the name photocell for the photo resistive device . . .



Phototubes are diodes consisting of an anode and a cathode sealed inside a glass envelope which has been exhausted and into which, in some types, a small amount of a rare gas has been admitted.

Photo resistive cells . . . are much smaller and more rugged than any of the photo emissive types. Yet, their sensitivity exceeds all but the photo multiplier tubes in some cases. Excellent, long wavelength response, beginning in the visible red region and extending far down into the infrared region is typical of these cells . . . A photo operated relay using a gas phototube and a small thyratron is shown . . . (*From 6-page Brochure "Phototubes and How to Use Them." PA-227, CBS-Hytron, Danvers, Mass.*)

FOR THIS LITERATURE CIRCLE 160 ON READER-SERVICE CARD

Speed—An Automatic Coding System For The LGP-30

In the SPEED Compiling system, the techniques of preparing a problem for a computer are essentially reduced to the elementary rules of algebra. Techniques of scaling need not be considered as all work is done in floating point. In addition, all storage allocation is accomplished by the system thereby eliminating the need for learning special operations or addressing methods. When entering the problem description and the data, a standard typewriter keyboard is used . . .

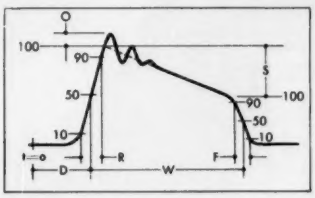
input
[[a + b + c] x d + sin [a x t]] : y
print y stop

The first information entered into a computer must always be a statement of the problem. In the SPEED system, the statement of the problem is a series of algebraic expressions as in the preceding example brackets [ ]; operations +, x, sin; and symboles a, b, c, d, t, and y are employed . . . (*From new 8-page Bulletin 507, Data Processing Div., Royal McBee Corp., Westchester Ave., Port Chester, N. Y.*)

FOR THIS LITERATURE CIRCLE 161 ON READER-SERVICE CARD

Pulse Generators

Pulse circuits have a transfer function (relation of output to input) in the time domain in the same fashion as sine wave circuits have a transfer function in the frequency domain. This function is expressed as the output of a circuit with a step function (zero rise time) input applied at zero time. . .

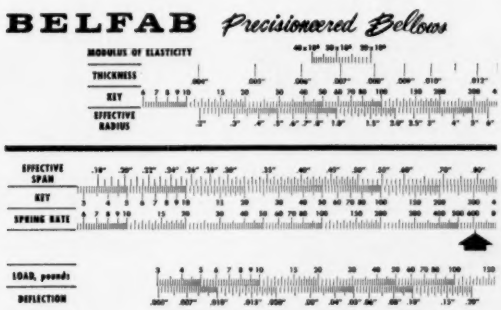


Pulse definitions are somewhat arbitrary but are generally accepted as indicated in Figure. R is the rise time, or leading edge time, commonly measured on the pulse leading edge for either pos. or neg. pulses. F is the fall of time or trailing edge time. D is the delay from a reference and W is the pulse width or duration. S is the top slope and is usually expressed in percent of leading edge 100% amplitude, as is the overshoot O . . . (*From new* 50-*page* 1959/60 *General Catalog, Electro-Pulse, Inc.,* 11861 *Teale St., Culver City, Calif.*)

FOR THIS LITERATURE CIRCLE 162 ON READER-SERVICE CARD

Bellows Design

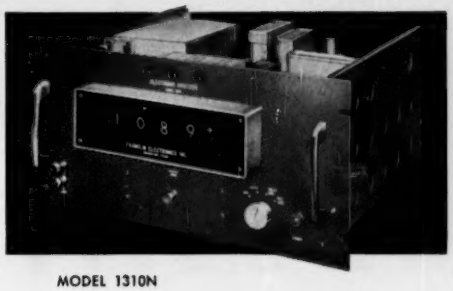
A metallic bellows of any type behaves, in part, like a helical spring. The spring rate (pounds of force per inch of movement) is a direct function of the elasticity modulus, and of approximately the square of the thickness of the material. It is also a function of the outside diameter and of the number of convolutions and their curvature . . . A bellows departs from the



simple helical spring analogy, however, in that it gets added "length" of material from the depth of the convolution. The depeer the convolution, the greater the length of spring material . . . One other factor is important. In a welded bellows, the shape of the walls of the convolution can be controlled. The convolution forms used are computed curves, exactly suited to the particular design. They may be simple or compound, with or without flats depending on the results desired. This represents a major advance in bellows technology . . . (*From new* 20-*page Bellows Design Manual and free Slide Rule, Belfab Corp.,* 94 *Hobson Ave., Hamden, Conn.*)

FOR THIS LITERATURE CIRCLE 163 ON READER-SERVICE CARD

FRANKLIN SERIES 1300



MODEL 1310N

ANALOG-TO-DIGITAL CONVERTERS

indefinite long-term stability

± one count accuracy

. . . two good reasons why Franklin's Series 1300 instruments are preferred in dozens of demanding applications. But there's more . . .

Series 1300 Analog-to-Digital Converters are available in four basic configurations—off-the-shelf, ready-to-operate. Matching accessories perform additional functions—convert codes, extend sensitivity, provide for a-c input signals, furnish automatic features . . . give the engineer complete freedom in his data system design.

For all the facts, request Bulletin 606.

ANALOG-TO-DIGITAL CONVERTERS

MODEL	* INPUT SIGNAL	READOUT	POLARITY AND DECIMAL INDICATION
1310	000.0 TO 120.0 V DC	VERTICAL	NO
1310N	SAME AS MODEL 1310	IN-LINE (NIXIE)	YES
1321	000.0 TO 120.0 V DC, 1 TO 100,000 MMF	VERTICAL	NO
1321N	SAME AS MODEL 1321	IN-LINE (NIXIE)	YES

* FOR SENSITIVITIES UP TO 100 MICROVOLTS PER DIGIT, SEE THE FOLLOWING LISTING.

FUNCTION AND RANGE EXTENDING AMPLIFIERS

MODEL	GAIN RANGES	GAIN SWITCHING			AUTOMATIC POLARITY
		LOCAL	REM.	AUTO.	
319RA	1, 10, 100, 1000	YES	NO	YES	YES
319R	1, 10, 100, 1000	YES	YES	NO	NO
319	1, 10, 100, 1000	YES	NO	NO	NO
318RA	1, 10, 100	YES	NO	YES	YES
318R	1, 10, 100	YES	YES	NO	NO
318	1, 10, 100	YES	NO	NO	NO

FRANKLIN electronics, inc.

BRIDGEPORT • PENNA.

CIRCLE 38 ON READER-SERVICE CARD

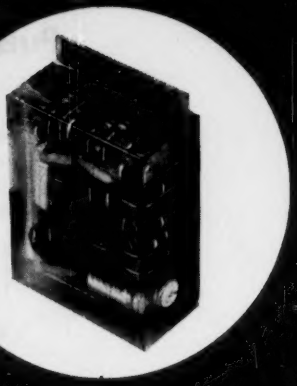
! ! ! NEW ! !

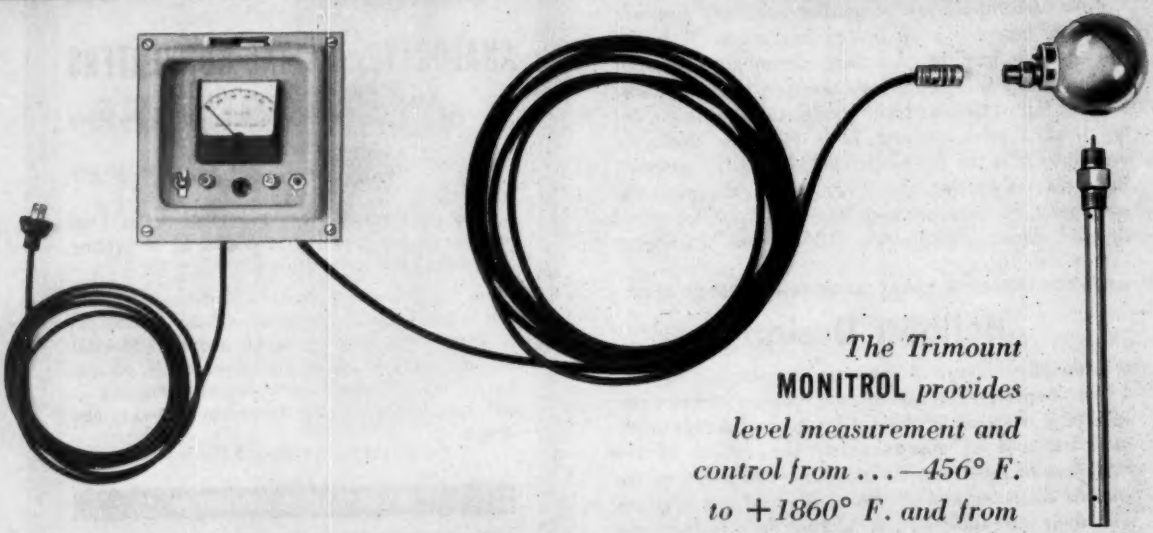
from TRIMOUNT

the finest, highest developed

in level indicators and control

the MONITROL





The Trimount **MONITROL** *provides level measurement and control from . . . —456° F. to +1860° F. and from 1.0 micron to 10,000 psi.*

The Trimount MONITROL is an ultra-sophisticated solid state device operating on the principle of a change in the electrical field displayed by any material. This change is a linear function of material or liquid level. The MONITROL represents the highest advancement in the art of level measurement and control.

UNSURPASSED RELIABILITY—Plug-in modules are completely transistorized and encapsulated in epoxy. Components cannot break loose or short out.

LINEARITY AND REPEATABILITY are inherent in the MONITROL, since the unit incorporates Trimount's unique and exclusive Delta C detector.

ACCURACY AND RUGGEDNESS were designed and engineered into the MONITROL . . . the unit performs efficiently under the most extreme conditions. The MONITROL can be used with liquids, solids and viscous materials.

MEASUREMENT AND CONTROL functions are combined in one compact, easily operated unit. Distance between probe-Delta C unit and power-supply readout can be as much as two miles with no loss in accuracy and stability!

SPECIFICATIONS

SENSITIVITY ..... 3 Microamps per microinch change

LINEARITY ..... Better than 1%

STABILITY ..... Better than .5% for ± 10% line voltage fluctuation

OUTPUT ..... 125 Millivolts into 2,000 ohms

METER ..... 50 microamp full scale

Scale Graduated 0-100% high and low control points, adjustable over entire range

Write for further information

TRIMOUNT INSTRUMENT COMPANY

DEPT. JCE-124 • 5717 WEST LAWRENCE STREET • CHICAGO 30, ILLINOIS

CIRCLE 29 ON READER-SERVICE CARD

T

Lockheed's endless-loop tape recorders

DEVELOPED FOR SPACE COMMUNICATIONS, the recording capabilities of Lockheed's new endless-loop tape recorders are creating interest wherever the need exists for stored data in a critical environment. The original design is now operational in delayed and continuous recording and playback of stored data. Its endless-loop mechanism records and plays back in the same direction of tape travel . . . without rewind.

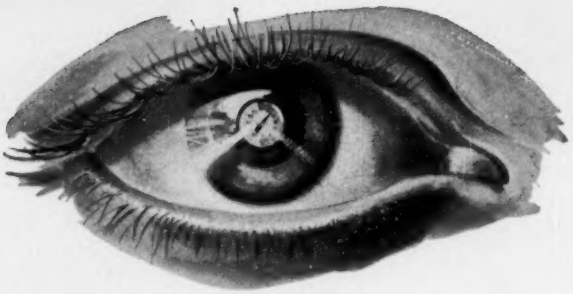
Variations of this lightweight, small size, low power consumption unit are available in a wide range of tape speeds and multiplicity of tracks. For more information on advanced recording techniques to meet your recording needs, write Marketing Branch, Lockheed Electronics and Avionics Division, 6201 East Randolph Street, Los Angeles 22, California.

Look to Lockheed for LEAD*ership in Electronics*

LOCKHEED ELECTRONICS & AVIONICS DIVISION

REQUIREMENTS EXIST FOR STAFF AND SUPERVISORY ENGINEERS

CIRCLE 40 ON READER-SERVICE CARD



What you read is right

The new, patented Maxivision dial on American Bi-Metal Thermometers eliminates the perspective effect of usual pointer-above-dial construction. No parallax! Readings are sure, sharp and accurate – exact working temperatures are always right before your eyes. It is a two-level dial. A raised outer ring, set close to the cover glass, carries the graduations. The index type pointer is on the same plane as the outer ring, with the numerals on a lower level.

What you read is right when American Bi-Metal Thermometers with anti-parallax Maxivision dial are installed at important check points on your processing facilities. Mounting styles, dial sizes, temperature ranges and stem lengths are available to meet the most exacting requirements. Let your nearby industrial distributor help you select the best combination for each location.

American Bi-Metal Thermometer with Maxivision Dial. Suitable for indoor or outdoor service.

MAXWELL MANNING & MOORE INC. MM&M TRADE MARK

A2-58R

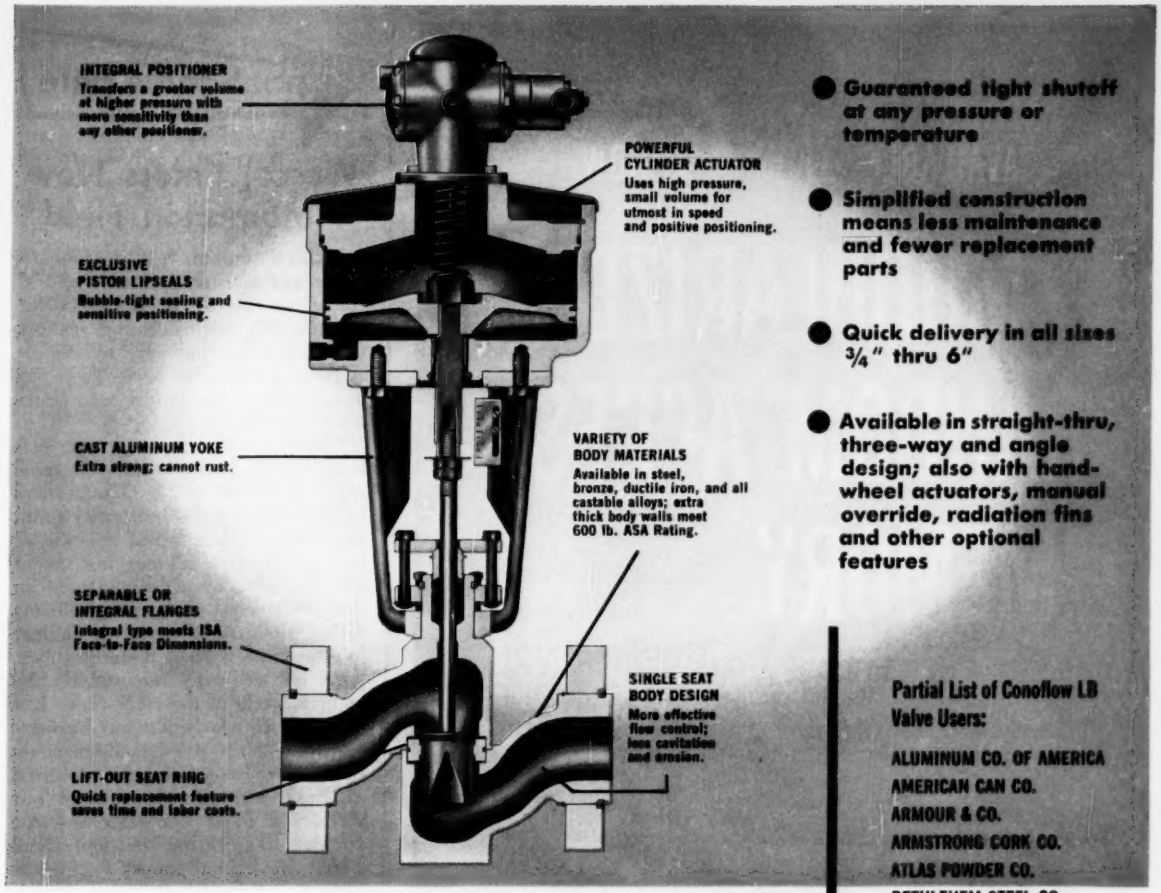
AMERICAN INDUSTRIAL THERMOMETERS

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

CIRCLE 41 ON READER-SERVICE CARD


INTEGRAL POSITIONER
Transfers a greater volume at higher pressure with more sensitivity than any other positioner.
POWERFUL CYLINDER ACTUATOR
Uses high pressure, small volume for utmost in speed and positive positioning.
EXCLUSIVE PISTON LIPSEALS
Bubble-tight sealing and sensitive positioning.
CAST ALUMINUM YOKE
Extra strong; cannot rust.
VARIETY OF BODY MATERIALS
Available in steel, bronze, ductile iron, and all castable alloys; extra thick body walls meet 600 lb. ASA Rating.
SEPARABLE OR INTEGRAL FLANGES
Integral type meets ISA Face-to-Face Dimensions.
SINGLE SEAT BODY DESIGN
More effective flow control; less cavitation and erosion.
LIFT-OUT SEAT RING
Quick replacement feature saves time and labor costs.

- **Guaranteed tight shutoff at any pressure or temperature**
- **Simplified construction means less maintenance and fewer replacement parts**
- **Quick delivery in all sizes ¾" thru 6"**
- **Available in straight-thru, three-way and angle design; also with hand-wheel actuators, manual override, radiation fins and other optional features**

Partial List of Conoflow LB Valve Users:

ALUMINUM CO. OF AMERICA
AMERICAN CAN CO.
ARMOUR & CO.
ARMSTRONG CORK CO.
ATLAS POWDER CO.
BETHLEHEM STEEL CO.
CROSSETT PAPER MILLS, INC.
CROWN-ZELLERBACH CORP.
DOW CHEMICAL CO.
GENERAL FOODS CORP.
HAMMERMILL PAPER CO.
HERCULES POWDER CO.
JONES & LAUGHLIN STEEL CO.
KIMBERLY-CLARK CORP.
OLIN MATHIESON CHEM. CORP.
MERCK SHARP & DOHME
PABST BREWING CO.
REYNOLDS ALUMINUM CO.
JOS. SCHLITZ BREWING CO.
SCOTT PAPER CO.
SEAGRAM DISTILLERS CO.
E. R. SQUIBB & SONS
UNION CARBIDE CORP.
U. S. RUBBER CO.
U. S. STEEL CORP.
WEYERHAEUSER TIMBER CO.

USERS FROM COAST TO COAST SPECIFY

"CONOFLOW LB VALVES

for Automatic Control that's Headache-Proof"

When company after company switches to Conoflow LB control valves—and constantly reorder—there must be a reason. Leading manufacturers use Conoflow LB valves because they want headache-proof control—and they get it. Specify Conoflow LB valves for performance, economy and dependability—*complete* satisfaction. For additional information telephone your Conoflow representative (located in principal cities); or write to Conoflow Corporation, 2100 Arch Street, Philadelphia 3, Pa. for Bulletin LB-3.

CC902

CONOFLOW CORPORATION
FOREMOST IN FINAL CONTROL ELEMENTS

SUBSIDIARY WALWORTH

CIRCLE 42 ON READER-SERVICE CARD

AVAILABLE NOW

MODULARIZED RANDOM ACCESS MEMORY

COMPUTER CONTROL COMPANY announces the availability of its new on-line, digital magnetic core, random access memory

FEATURES:

- Word capacities up to 4096 words (you specify).
- Word lengths up to 40 bits/word (you specify).
- Access time to any address — 4 μsec.
- Cycle time — 8 μsec.
- Modular plug-in etched circuits.
- High reliability and ease of maintenance.

Write for eight-page Bulletin TCM

COMPUTER CONTROL COMPANY, INC.

92 CONCORD STREET
FRAMINGHAM, MASSACHUSETTS

WESTERN DIVISION
2251 BARRY AVENUE
LOS ANGELES 64, CALIFORNIA

CIRCLE 43 ON READER-SERVICE CARD

panhandle pete

Wesco! Enters New Automation Field

It was with a sense of great opportunity and decision that we WESCO! executives entered W. K's office for our monthly brainstorming session, (we call each other only by initials at these sessions so as to keep our importance at the top of each brain while it is storming).

These monthly brainstorming sessions are all that *Fortune* magazine makes them out to be. You readers of this column know how many problems WESCO has solved this way—how we changed all our instrument peddlers into systems engineers so they could meet company presidents rather than instrument mechanics; how we used market research to expand our company into exactly the right markets at the right time; like the time we nearly lost our business when we had to pay income taxes on our Himmelrakets, and how we saved WESCO! only by the skin of our teeth, the O. J. Computer and the Systems Engineering Division, which barely lost enough money to save the company; how we upgraded our entire profession by proper use of first letters, alphabetical appelations, and slogans.

"We can face the future unafraid," said our genial sales manager, W. K. (that's Waldo Klapsaddle), as he smiled at our Chief Engineer J. L. (John L. Bus Wallace), Flight Engineer A. F. (Andy Francy), Director of Research O. U. A. (Otto U. Alles), Engineer, E. F. (Elmer Flannelgurdle) and me P. P. (instrument pedd—oops, systems engineer).

"I'm just a bit concerned about the future," counters E. G. (that's really Elmer), "what with Khrushchev liable

The Automatic Factory

by June, et al . . . a fresh viewpoint on what "manless factories" can be . . . free from the generalities, and misconceptions so prevalent on this subject. Cloth, 88 pages, 1955, $1.50.

Nuclear Reactors for Industry and Universities

edited by E. H. Wakefield. The several distinguished authors and editor Wakefield cover types, availability (1954), operation, protection, control, experiments, legal aspects, and present a detailed cost study. Cloth, 92 pages, 1954, $2.00

Instruments Publishing Co.
845 Ridge Ave., Pgh. 12, Pa.

to sweet talk our innocent Ike into giving him Fort Knox, and us having only recently increased our losses in systems engineering to offset our profits in Himmelrakets. I have a terrible feeling of insecurity."

"You are worrying unnecessarily," says A. F., "The market for Himmelrakets will be good as long as a man remains without the right of self-determination anywhere in the world."

"But just in case, wouldn't it be smart to expand our lines into a profitable industrial field,?" queries J. L.

"That is indeed a brainstorm," replies O. U. A., "but we already have an Industrial Systems Division, a Systems Systems Division, a Computer Division, and a Kanarienvogle Analyzer Division. What have we missed?"

As if waiting for this leading question, J. L. whips out the editorial from a leading trade journal and reads: "A major misconception of today is the widely held view that automation is only for giant companies, who can afford the millions of dollars it takes for systems engineering and data logging. This is not true."

"Eureka," shouts A. F. in Greek. "You are a genius. Every small company also can't afford not to spend those millions either. Why increased efficiency, rapid and more accurate data is a *sine qua non* today," switching from Greek to Latin. "Nobody can do without a *sine qua non*—get out the order pads."

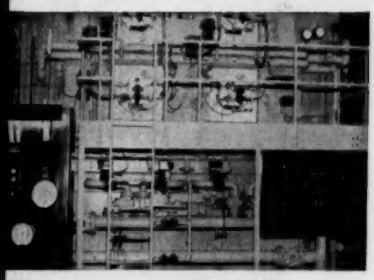
"No, no," say J. L., "you are off the beam. Nobody has figured out how to make a small company spend money it doesn't have. Only the larger company can do this. You are on the wrong track."

"Then why did you bring up the entire subject," snarls A. F., justifiably chagrined that neither his Greek, Latin nor profundities were appreciated. "Solve your own problem, my brain quits."

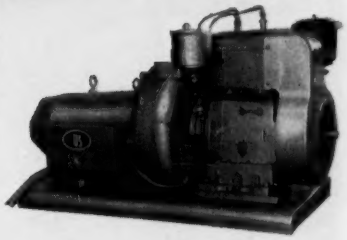
"Which is what I have done," replies J. L. "WESCO! will market a complete line of automation equipment for the small company, proving that automation is for the small company as much as the large. These equipments will include what every small company needs for automation —hand drills, ratchet screwdrivers, torque wrenches, counters, thermometers, pressure gages, rotameters, why the list is endless, and this is a virgin field of automation that has been completely abandoned by all other instrument manufacturers! Nobody's been selling such stuff for years. Let's go after it."

Panhandle Pete

DOUGLAS AIRCRAFT



MICRO-POWER



In plants like Douglas Aircraft Company, Inc., in Tulsa, Oklahoma, where a continual supply of steam is vital to production processes, every precaution must be taken to assure against the hazards of boiler flame-out. To safely regulate the shutting down of its burners in the event of flame-out, the company utilizes highly sensitive electric controls. Since these flame failure controls *are* electric and must depend on a constant, unwavering power supply for successful operation, a further precaution is taken... MICRO-POWER.

At Douglas Aircraft in Tulsa, Micro-Power serves as the dependable rear guard to the boiler room. It provides a constant source of steady, independent electrical power as required by the safety controls, thereby eliminating voltage fluctuations and protecting against power failure.

MICRO-POWER IS ALSO USED...

- on microwave installations for communications, for remote control, for telemetering.
- for refinery and chemical process indication and control.
- by public utilities for protective relaying, telemetering and load distribution.

MICRO-POWER PROVIDES...

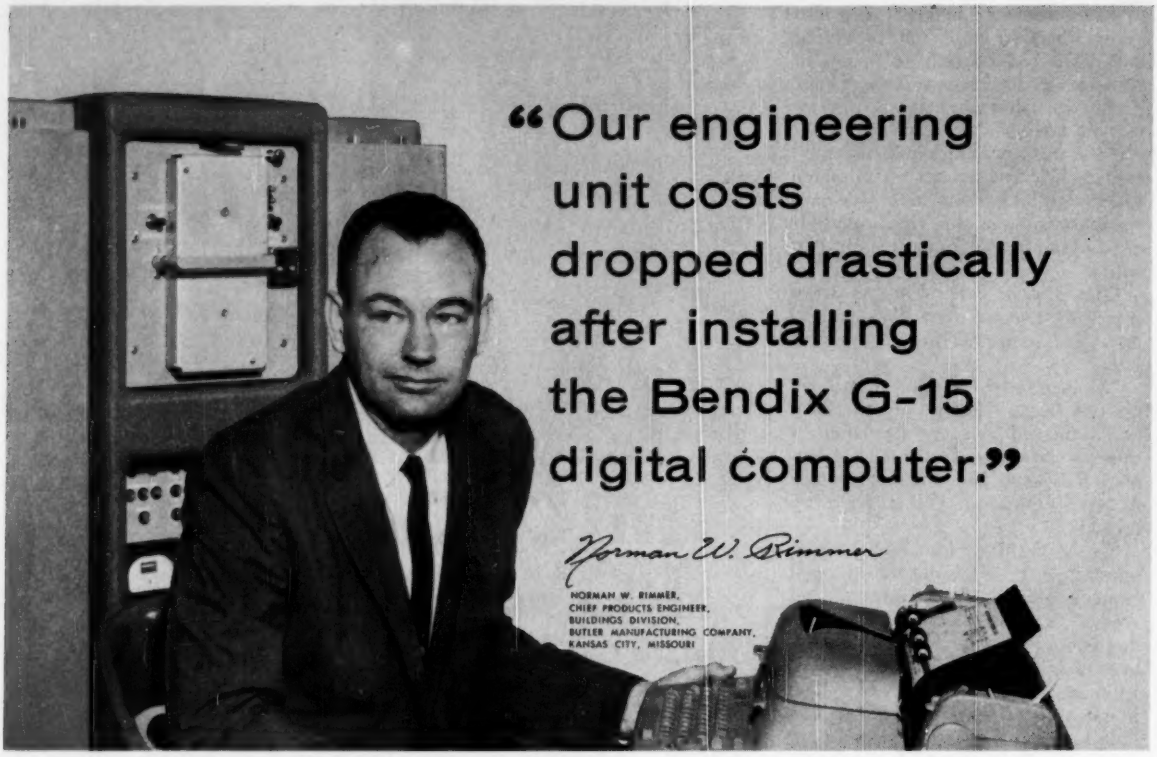
- a constant source of electric power.
- voltage and frequency at usable value during transfer from motor to engine.
- stable voltage output.
- flywheel starting — no storage batteries.
- electrical isolation from commercial source — no voltage dips or peaks to affect microwave equipment — no transfer switch.
- return to motor drive after commercial power restoration without interruption of voltage.

The Douglas Aircraft Company, Inc., Tulsa Division, "Micro-Power" application is just one of a wide range of uses for this versatile standby power unit. For complete product and application information, call or write...

UNITED STATES MOTORS CORPORATION — MICRO POWER — US — OSHKOSH • WISCONSIN

UNITED STATES MOTORS CORPORATION
102 West Fifth Avenue
OSHKOSH, WISCONSIN

CIRCLE 44 ON READER-SERVICE CARD


"Our engineering unit costs dropped drastically after installing the Bendix G-15 digital computer."
Norman W. Rimmer
NORMAN W. RIMMER,
CHIEF PRODUCTS ENGINEER,
BUILDINGS DIVISION,
BUTLER MANUFACTURING COMPANY,
KANSAS CITY, MISSOURI

Butler's progressive engineering program requires a fast, versatile, and low-cost computer. It must handle complex structural problems and still be simple enough to be used by engineers with no programming experience. The computer's mission: cut engineering unit costs. *"Our own survey proved that the Bendix G-15 digital computer could best do this job,"* says Mr. Rimmer, *"and it does."*

For Butler, part of the cost-cutting versatility of the G-15 stems from the variety of programming methods they can use. For the solution of repetitive problems at highest speeds, they use the machine language system. With the simplified Intercom 1000 system, the entire staff uses the computer for structural design problems. This versatility also means the G-15 can be used for business data processing as well as scientific and design calculations.

Butler is also pleased with the expandability of the G-15. They know that as their computing requirements grow, they can add magnetic tape units, punched card equipment, digital differential analyzers, plotters, and other accessories. Remember, however, that the basic G-15, which includes a unique photo-electric tape reader-punch and alphanumeric typewriter, is more than adequate for most problems.

Find out more about this computer — the *only* medium-scale computer in the low-price field. Inquiries regarding specific applications are welcomed.

Bendix® Computer

DIVISION OF BENDIX AVIATION CORPORATION

DEPT. J-16

LOS ANGELES 45, CALIFORNIA

CIRCLE 45 ON READER-SERVICE CARD

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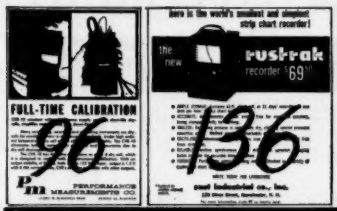
Produces more quality sales leads than any other monthly publication in the field. The heavy figures shown below indicate the number of sales leads from one insertion. Readers' direct-to-advertiser leads not included.



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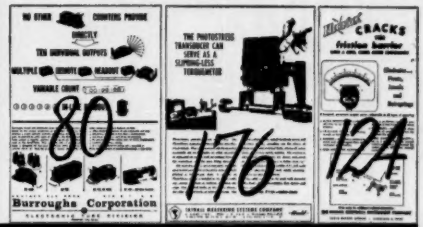
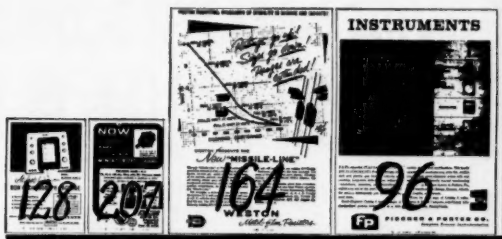
For 32 years the leader and pioneer publication. Serves the broad field of industrial and scientific instrument-control equipment and systems users with primary emphasis on process and general industrial control applications. Leads in total number of advertisers and exclusive advertisers. Standard format. 30,000 circulation.



INSTRUMENT & APPARATUS NEWS

Serves the laboratory, OEM and industrial market. Over 90,000 copies distributed to customers of equipment and component distributors who pay the publisher for each recipient. The industry's only tabloid. Issued bi-monthly.



60,000 SALES LEADS PER AVERAGE ISSUE

IAN is the country's top product promoter. Only 36 issues produced the staggering total of 1,911,723 sales leads forwarded to manufacturers. The heavy figures on each ad, shown at the left, indicate the number of sales leads forwarded to manufacturers.

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The bi-monthly, king-size magazine devoted to design and application of instrumentation and control in the military equipment market. Read by over 30,000 qualified verified men in government and military-end-product manufacturing industry.

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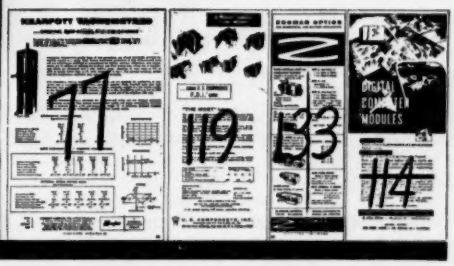
UNDUPLICATED COVERAGE . . . 150,000 USERS AND BUYERS

Use all 3 publications for complete coverage of the industrial and military instrument/control/systems market. A 10% discount applies to equivalent space used in two or all three publications.



Write for Market-Media data, and sample miniature "marked copy" of IAN and MSD.

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THE PRACTICAL LOW COST ANSWER TO MULTI-CHANNEL OSCILLOGRAPHIC RECORDING PROBLEMS ··· SANBORN INTRODUCES THE FIRST OF THE 950 SERIES ··· THE 950-1500 SYSTEM ··· FOR FLOATING OR GROUNDED INPUTS FROM 10 μV TO 0.1 VOLT PER DIVISION ··· ALL-TRANSISTORIZED ELECTRONICS MOUNTED BEHIND A SINGLE 7" HIGH PANEL ··· FLUSH-FRONT RECORDER WITH 9 ELECTRICALLY-CONTROLLED CHART SPEEDS ··· IMPROVED, RUGGED GALVANOM-ETERS ··· CLEAR, INKLESS TRACES ··· RECTANGULAR COORDINATE RECORDINGS ··· ALL IN A SYSTEM DE-SIGNED SPECIFICALLY TO PROVIDE GREATER ECONOMY AND ACCURACY WHEN SYSTEM FLEXIBILITY IS NOT REQUIRED.

Additional features of the 950-1500 include: common power supply, built-in MOPA, front and rear inputs, easily serviced plug-in circuit cards, adaptability for use with other readout devices. When many channels are constantly in use for floating or grounded high gain inputs the simplified 950-1500 design assures dependable operation, yet at much lower "per channel" cost.

Complete details are available from Sanborn Sales-Engineering Representatives located in principal cities throughout the U.S., Canada and foreign countries.

SPECIFICATIONS

INPUT	100,000 ohms, all ranges, floating and guarded.
OUTPUT	400 ma. full scale, 15 ohms nominal load, ungrounded
LINEARITY	±0.4%
SENSITIVITY	10, 20, 50, 100, 200, 500, 1000 and 2000 uv per chart div
COMMON MODE REJECTION	100 db, min. dc
FREQUENCY RESPONSE	0-100 cps within 3 db at 10 div peak to peak. 0-50 cps within 3 db at 50 div peak to peak.
NOISE	¼ div peak to peak maximum.

(All data subject to change without notice)

NEREM '59 Comm. Armory, Boston, November 17, 18, 19.

SANBORN COMPANY

INDUSTRIAL DIVISION 175 Wyman Street, Waltham 54, Massachusetts

CIRCLE 47 ON READER-SERVICE CARD

book reviews

Guide du Controle Industriel (Industrial Control Guide), second edition, [c 1959] Editions B.P.I., 79 Avenue des Champs-Elysées, Paris 8°, France, 484 p., 8½", clothbound Fr. 2,700. Contains alphabetical index of instruments and trademarks; classified lists of measuring, testing, and lab instruments, control and automation systems, components and accessories; also catalog of French manufacturers, importers and representatives of foreign manufacturers, with English subtitles.

Absperrorgane in Rohrleitungen (Manual Control Elements in Pipelines) by Walther Volk, [c 1959] Verlag Springer, 3 Heidelberger Platz, Berlin-Wilmersdorf (West Berlin), 178 p, 9", clothbound DM 25.50. Book reflects the difference in the American and German approach to the subject in that it contains descriptions of *special* hand-operated elements of many designs used in a pipeline, while the basic American classifications of globe valves, gate valves, cocks, etc. are hardly mentioned. Besides illustrations and descriptions, much theory in form of strength and force calculations (including calculus) is used. Chapter on butterfly valves will prove valuable to specialists.

A Short Dictionary of Mathematics, by C. H. McDowell, [c 1957] Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y., 63 p., 7¼", clothbound $2.75. Divided into two parts (Arithmetic and Algebra; and Plane Trigonometry and Geometry), the book describes the most common terms in uncomplicated language and examples.

Anwendung von Rechenmaschinen bei der Berechnung von Regelvorgaengen (Application of Computers in Calculations of Automatic Control Systems), edited by W. Oppelt [c 1958] R. Oldenbourg, 145 Rosenheimer Str., Munich, West Germany, 128 p., 9¼", clothbound DM 16.80. Collection of papers read at the Conference of the Committee for Control Mathematics of the Society for Applied Mathematics and Mechanics (Fachausschuss Regelungsmathematik der Gesellschaft fur angewandte Mathematik und Mechanik, GAMM) held in Dusseldorf November 8, 1957. Includes a paper read in English on "A Simple Graphical Method for Deconvolution" by J. B. Reswick, Cambridge, Mass., and

(*Continued on p.* 1505)

the world's most expensive inch of recording tape

There's no question about it—if there were a dropout in this inch of tape it could cost you plenty. That's why our customers invariably demand perfection from our EP Audiotape —the *extra precision* magnetic recording tape for computers, automation, telemetry and seismography.

Audio Devices' battery of Automatic Certifiers is one of the unique means used to make sure EP Audiotape always meets customers specifications. The Automatic Certifier records and plays back every inch of the EP Audiotape under test. These tests can be so demanding that if the tape fails to reproduce just *one* test pulse out of the 40 million put on a single reel, the entire reel is rejected. There are no *if's, and's,* or *but's.*

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For more information write for free Bulletin T112A. Write Dept. TI, Audio Devices, Inc., 444 Madison Avenue, New York 22, N. Y.

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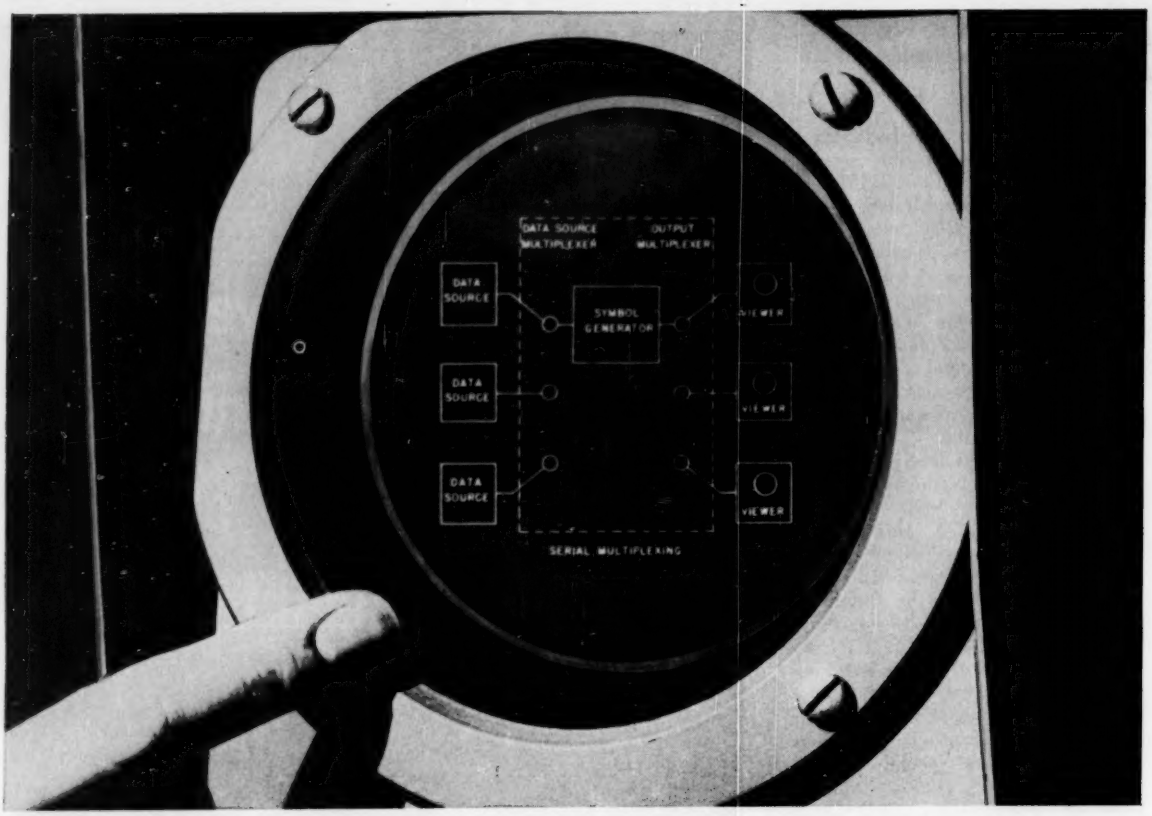
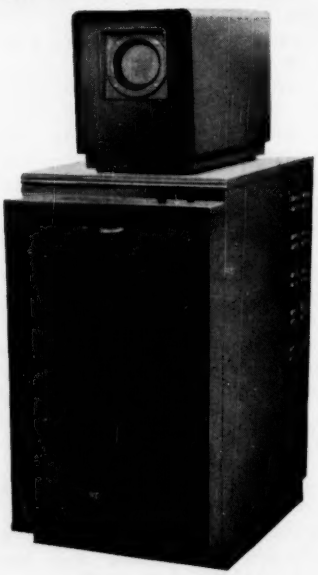


NOW . . . a complete data display system at unusually low cost.

NOW . . . by using LFE's exclusive SM Symbol Generator and Viewers you can custom design a complete data display system at unusually low cost. Only *one* symbol generator is required to operate any number of viewers . . . by series or parallel multiplexing . . . each with a different display. No other display system offers this flexibility. The result is exceptionally low cost.

The SM translates coded data into the written word from any digital data source . . . computers, tape units or teletype lines. Any number of sources can supply data to the same viewer, or each viewer can be attached to one source only . . . both viewers and source can be remote. The SM quickly generates and displays alpha-numeric characters, arbitrary or abstract symbols, graphs, charts or maps. Display rate is 20,000 characters per second . . . more than 64 different characters . . . 600 characters per display . . . accepts data at non-uniform rates. Display can be held indefinitely until erased. For complete specifications write for Bulletin 81.



SYMBOL GENERATOR AND VIEWER

Computer Products Division

LABORATORY FOR ELECTRONICS, INC.
1079 COMMONWEALTH AVENUE, BOSTON

CIRCLE 49 ON READER-SERVICE CARD

BOOKS

Continued from page 1503

other papers on applications of analog computers by Austrian, Belgian, German, and Italian scientists.

Organic Chemistry by Ray Q. Brewster and William E. McEwen, second revised edition, [c 1948, 1949, 1959] Prentice-Hall, Inc., Englewood Cliffs, N. J., 401 p., 9″, clothbound $10.00. Subtitle calls book "A Brief Course" and preface allots one semester or two quarters to the student. The electronic theory has been utilized in the explanation of the properties of various classes of compounds.

Electronic Digital Computers by Charles V. L. Smith, [c 1959] McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N. Y., 443 p., 9″ clothbound $12.00. Book describes basic principles of digital computers from the first machine developed at the Institute for Advanced Study. Assembly of basic circuits and interconnections are shown without going too far into the engineering. A large chapter is devoted to Boolean algebra, but it is not a theoretical treatise.

NEW MINIATURE PRESSURE TRANSDUCER BY COLVIN

- Only one inch square – one inch long
- Withstands high vibration

35 G to 5000 CPS 0-3 to 0-400 psi
400 to 10,000 ohms

AVAILABLE IMMEDIATELY

COLVIN LABORATORIES, INC.

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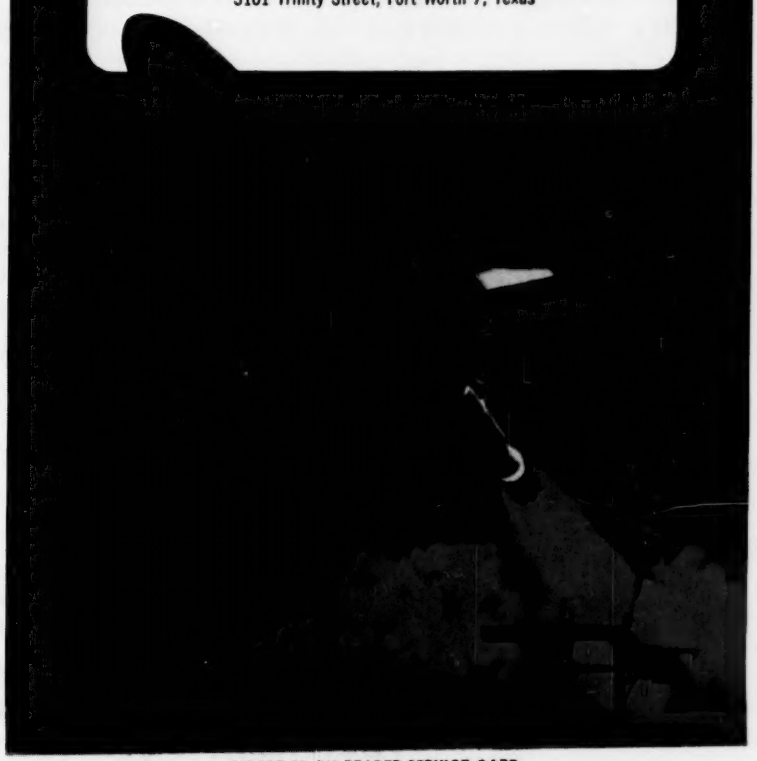
SUCCESSFUL LAUNCH...

There's solid assurance in the high accuracy of Howell Instrument's Ta'Pot®, the "tape-slidewire" potentiometer used as the key measuring unit to check, *before* launch, The Martin Company's USAF TM-76 "Mace" engine r.p.m. and temperature systems– and which is the go/no-go control *during* launch.

The Ta'Pot is a straight wire (or helically wound!), embedded within the edge of a polyester tape. With calibration printed on the tape, this 12-feet long slidewire pot has up to 1200 readout scale points; or it may be geared to an in-line counter, and servo-driven in either case. *Or* the Ta'Pot may be manually operated for exact readout of functions...or for control of functions...or for computer inputs. Electronic calibration of Ta'Pot slidewires regularly achieves better than 0.05% conformity to either linear or non-linear functions. *The Ta'Pot is presently used in test cells, in jet engine analyzers, in jet aircraft cockpits and in a host of other critical applications.*

TA'POT®

HOWELL INSTRUMENT COMPANY
3101 Trinity Street, Fort Worth 7, Texas



CIRCLE 50 ON READER-SERVICE CARD

CRESCENT

POLYETHYLENE INSTRUMENT TUBING

Costs Less—Is Easier To Install

SIX DIFFERENT TYPES TO MEET YOUR SPECIFIC NEED

CRESCENT POLYETHYLENE MULTITUBE is 2 to 37 precision Polyethylene tubes *spirally cabled* together for greatest flexibility. The tubing assembly is protected against mechanical injury by an interlocked galvanized steel armor, Polyvinyl Chloride sheath, or other sheaths, as below.

CRESCENT POLYETHYLENE PRECISION INSTRUMENT TUBING

TYPE P is manufactured from the best high molecular weight virgin Polyethylene compound and TYPE XP of high modulus virgin Polyethylene compound selected for their superior resistance to environmental stress cracking and aging. Extensive research, improved manufacturing methods and rigid test standards have developed CRESCENT Polyethylene tubing to its present level of highest quality. It is furnished as single tubing in ¼", ⅜" and ½" sizes in up to eight bright colors. It is used exclusively in manufacturing CRESCENT POLYETHYLENE MULTITUBE in types as follows:

STANDARD TYPES

TYPE PA—Interlocked metallic armor provides complete mechanical protection.

TYPE PAT—Polyvinyl chloride sheath over the armor adds corrosion protection for the armor. Can be buried in the earth.

TYPE PT—PVC sheath gives limited mechanical protection. For use in troughs, trays or conduit.

SPECIAL SERVICE TYPES

TYPE XPT-U—Extra heavy PVC sheath over high modulus TYPE XP tubing permits direct burial, or use above ground where subject to moderate abuse.

TYPE XPT-F—Same as XPT-U with heavy asbestos braid and outer PVC sheath. Provides time delay in event of flash fire.

TYPE XPT-FA—Same as XPT-U with heavy asbestos braid and interlocked metallic armor. Provides complete mechanical protection, as well as time delay in event of flash fire.

TYPE PA

TYPE PAT

TYPE PT

TYPE XPT-U

TYPE XPT-F

TYPE XPT-FA

Write for complete information on these types, as well as types employing copper or aluminum tubing.

Ask for bulletin No. 458-A

CRESCENT INSULATED WIRE & CABLE CO., INC.

TRENTON, NEW JERSEY

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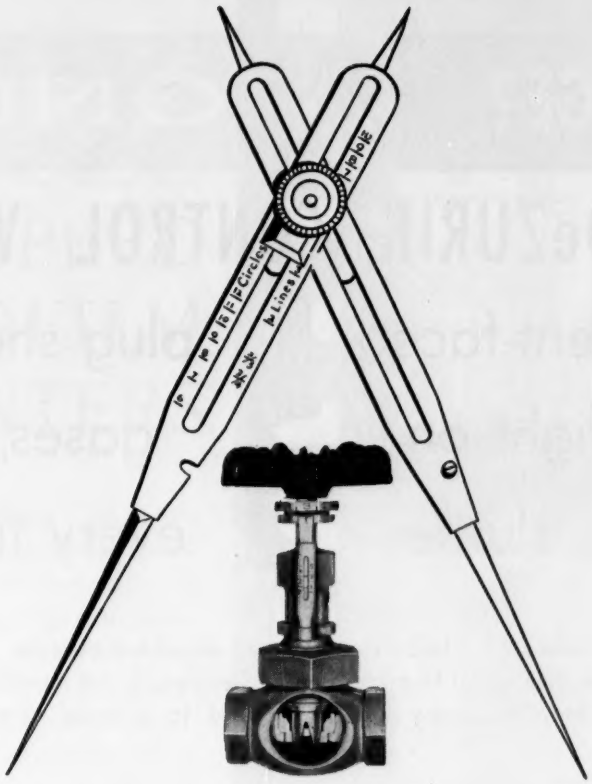


PROPORTIONER

controls flow to save for you

The V-port disc in all Hancock "Flocontrol" Valves insures proportional flow throughout the entire lift of the stem. They are valves that help you achieve uniform product quality through closer control, save steam and fuel on process work, and cut maintenance costs.

"3 in 1" valve design combines variable orifice with shut-off and micrometer dial and pointer. The valve opening can be set within 1/10 turn of the handwheel —you can duplicate all settings easily, instantly. No shut-off valve required—flow is in a straight line, with separate shut-off seating surface located away from the V-ports.

Hancock "Flocontrol" Valves are available in Bronze and Steel to meet the most demanding services. Ask your industrial supply distributor for details.

Hancock "Flocontrol" valves assure positive pinpoint control—eliminate all guesswork.

MAXWELL MANNING & MOORE INC. M&M TRADE MARK

HI-98

HANCOCK "FLOCONTROL" VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Watertown, Massachusetts

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

CIRCLE 52 ON READER-SERVICE CARD

LEAKAGE? NONE !

with DeZURIK CONTROL VALVES

This resilient-faced plug shuts dead-tight on gases, liquids, slurries every time!

Resilient seating is standard on a DeZurik Valve—not an added expense "extra". Actually this resilient seating costs LESS than metal to metal seating; lapping is not necessary. Plug life—even on slurries—is almost unlimited. The facing is solidly bonded to a metal core; there is no continual flexing.

CAPACITY? HIGH !

with DeZURIK CONTROL VALVES

Straight-thru flow and liberal port area reduce turbulence and erosion, permit higher capacity - size for size - than ordinary control valves!

Again, there's a saving in cost! A DeZurik Control Valve a size or two smaller and at a lower price, will often handle the same service handled by a higher priced, larger size ordinary control valve. And it will handle the service with less turbulence . . . . less erosion . . . . and a resultant longer valve life!

Find out more about the unusual advantages of DeZurik Control Valves. Ask the DeZurik representative in your area, or write for Bulletin 150.

DeZURIK CORPORATION
SARTELL, MINNESOTA

CIRCLE 53 ON READER-SERVICE CARD

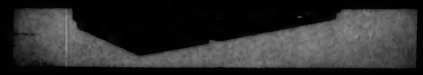
S-C 4020 HIGH-SPEED MICROFILM PRINTERS

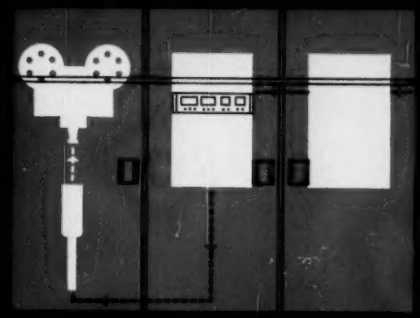
Capable of printing characters and plotting points at the rate of 15,000 per second, the S-C 4020 is equally adaptable to commercial and scientific applications where high-speed microfilming is required. This versatile new printer is compatible with most high-speed data processing systems used throughout business, government and industry . . . and is capable of both on-line and off-line cperation. The S-C 4020 has resulted from experience gained by Stromberg-Carlson in the development, manufacture and field testing of other microfilm printers in the S-C 4000 Series, including the S-C 4000, custom-developed for use with the Livermore Automatic Research Computer (LARC), and the S-C 4010, now used in conjunction with the Naval Ordnance Research Calculator (NORC).

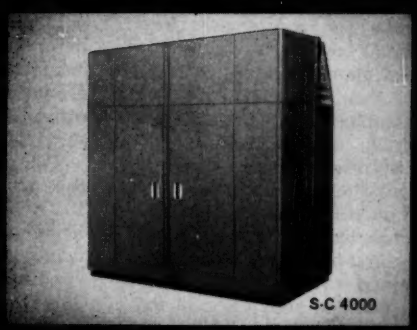
Send for complete information concerning the S-C 4020 High-Speed Microfilm Printer. Ask for Bulletin 6-C. Write today: Stromberg-Carlson - San Diego, 1895 Hancock Street, San Diego 12, California.

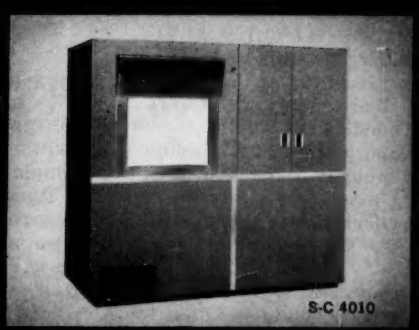
GENERAL DYNAMICS
STROMBERG-CARLSON DIVISION

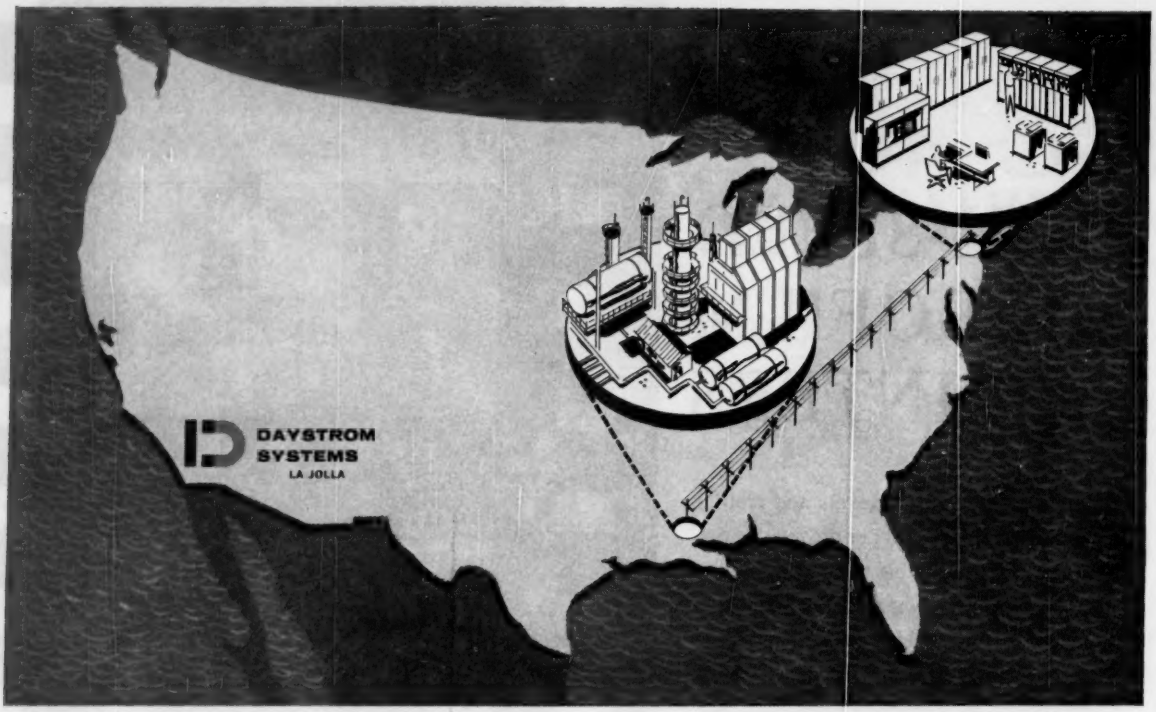
CIRCLE 54 ON READER-SERVICE CARD











Now...in addition to on-line computer systems

Operating and test data reduction via telephone link utilizing any computer facility

The new Daystrom TPR Scanning System represents a revolutionary approach with vast implications where there are requirements for immediate or continuous computer analysis of plant operating or test data. The availability of this new tool will influence industry's plans in a number of important areas, which include process studies, experimental test work in the military and nuclear areas, and testing for performance guarantees.

For the first time, the TPR (tape programmed raw) data scanner makes it possible and practical to link a test or operational plant facility directly to any computer in the country for instant computation of data. This is made possible by the utilization of standard telephone communication services, and permits stationing of all engineering and computer programming personnel at the project site, where all phases of the work may be handled.

The importance of this development is brought into sharp focus by the almost non-existence of computer facilities at actual plant or test sites. The utilization of telephone circuits completely circumvents this problem since it makes little difference whether the computer facility to be used is located in an adjoining building, company headquarters or at a rental facility. Distance represents no problem other than nominal telephone service charges.

Telephone communication of this type is a practical reality in the business machine field and is being used every day by leading companies for inventory control, accounting and other purposes. The Daystrom TPR Data Scanner is the first system that has been specifically designed to handle the problems involved in gathering large amounts of analog data peculiar to plant and test facility operation.

The TPR Data Scanner's feature of tape programming provides unlimited flexibility. This permits unrestricted application of the equipment to various types of facilities even though they may be completely different in nature.

Typical of the unequalled performance specifications are 0.1% accuracy at the 99% confidence level, together with extremely high signal to noise ratio at scanning rates up to 40 variables per second. 100% solid state circuitry and full parity checking are incorporated. Input channels may be as few as 100 or as many as 6000.

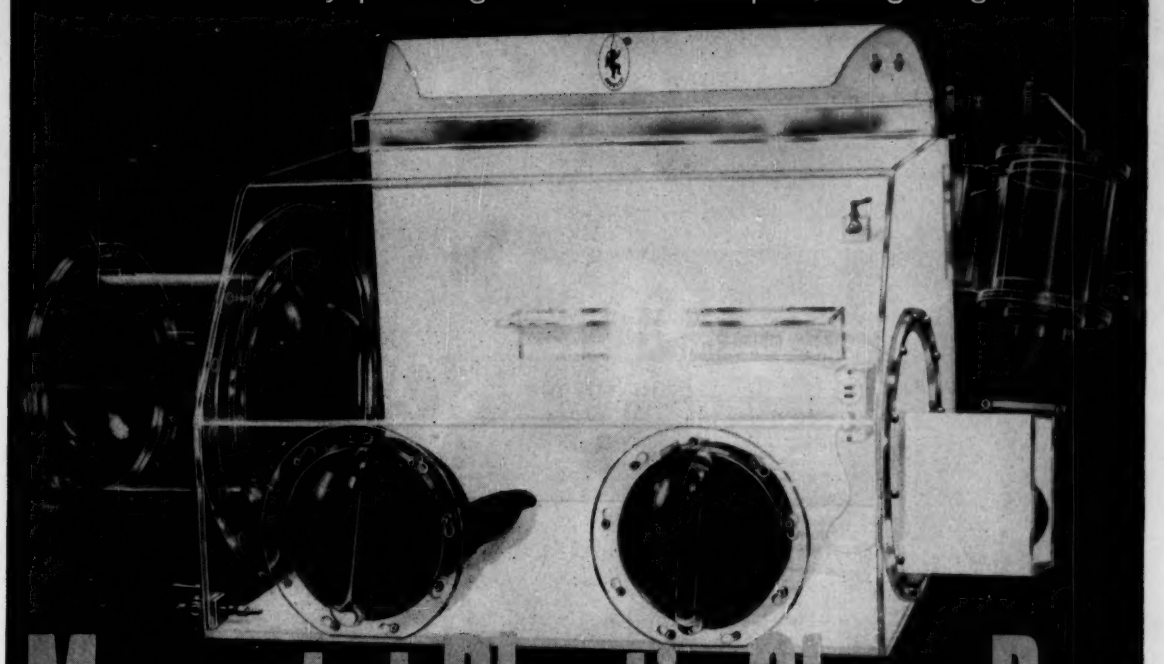
For further information, write or telephone Daystrom Systems, Dept. A-127, Miramar Road, La Jolla, Calif. GLencourt 4-0421.

Typical 2000 point system delivered to a major nuclear propulsion test facility.

DAYSTROM SYSTEMS
DIVISION OF DAYSTROM, INC.
Reliable computer control systems

CIRCLE 55 ON READER-SERVICE CARD

Now... Moderately priced glove boxes with positive gas-tight seals!



Manostat Plastic Glove Box

Manostat introduces Plastic Glove Boxes with true *one-piece* construction, achieved with a chemical weld. Despite their moderate price, these boxes are designed and constructed with such de-luxe features as positive "O" ring seals throughout, for leak-proof performance . . . and a full 18" diameter side entry, for maximum convenience. The ¼-inch thick Rohm & Haas Plexiglas 1-A is unaffected by most inorganic solutions, mineral and animal oils, low concentrations of alcohol, paraffinic and olefinic hydrocarbons, amines, alkyl monohalides, and esters containing more than ten carbon atoms.

FEATURES:

1. Positive "O" ring seals throughout.
2. Opaque white background for greater visibility.
3. Sealed interchangeable circulating and filter system.
4. Filter that may be removed and installed without disturbing system.
5. Interchangeable 12" diameter, 12" long air lock with covers.
6. Covers for gloves so that they may be changed without disturbing system.
7. Uniform distribution of flow from circulating system by means of graded manifold.
8. Internal removable shelf for storage.
9. Plastic diffuser on fluorescent light.
10. External switches for all controls.
11. S.S. toggle valves for quick adjustment and preconditioning of system, air lock and filter.

PRICE LIST:

T952 -- SIMPLE GLOVE BOX, ready use, with side cover plates and all other accessories, as shown. (Does not include air lock or circulating system.) **950.00**

T952D -- AIR LOCK GLOVE BOX, ready for use, with air lock and all accessories, as shown. (Does not include circulating system.) **1,150.00**

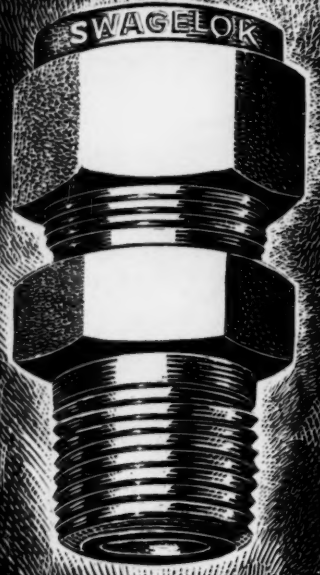
T952D10 -- CIRCULATING GLOVE BOX, ready for use, with circulating system and all accessories, as shown. (Does not include air lock.) **1,250.00**

T952D20 -- COMPLETE GLOVE BOX, ready for use, with air lock, circulating system, and all accessories, as shown. **1,495.00**

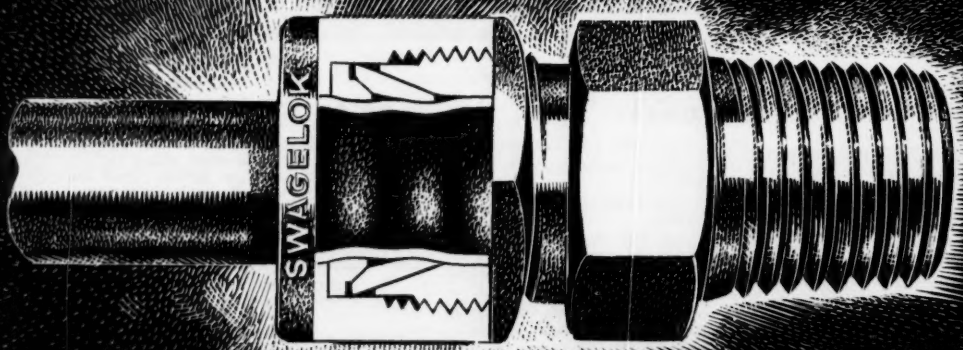
Write for Bulletin GB

The EMIL GREINER Co. 20-26 N. MOORE STREET • DEPT. 230, N. Y. 13, N. Y.

CIRCLE 56 ON READER-SERVICE CARD



the Standard of Quality in Tube Fittings

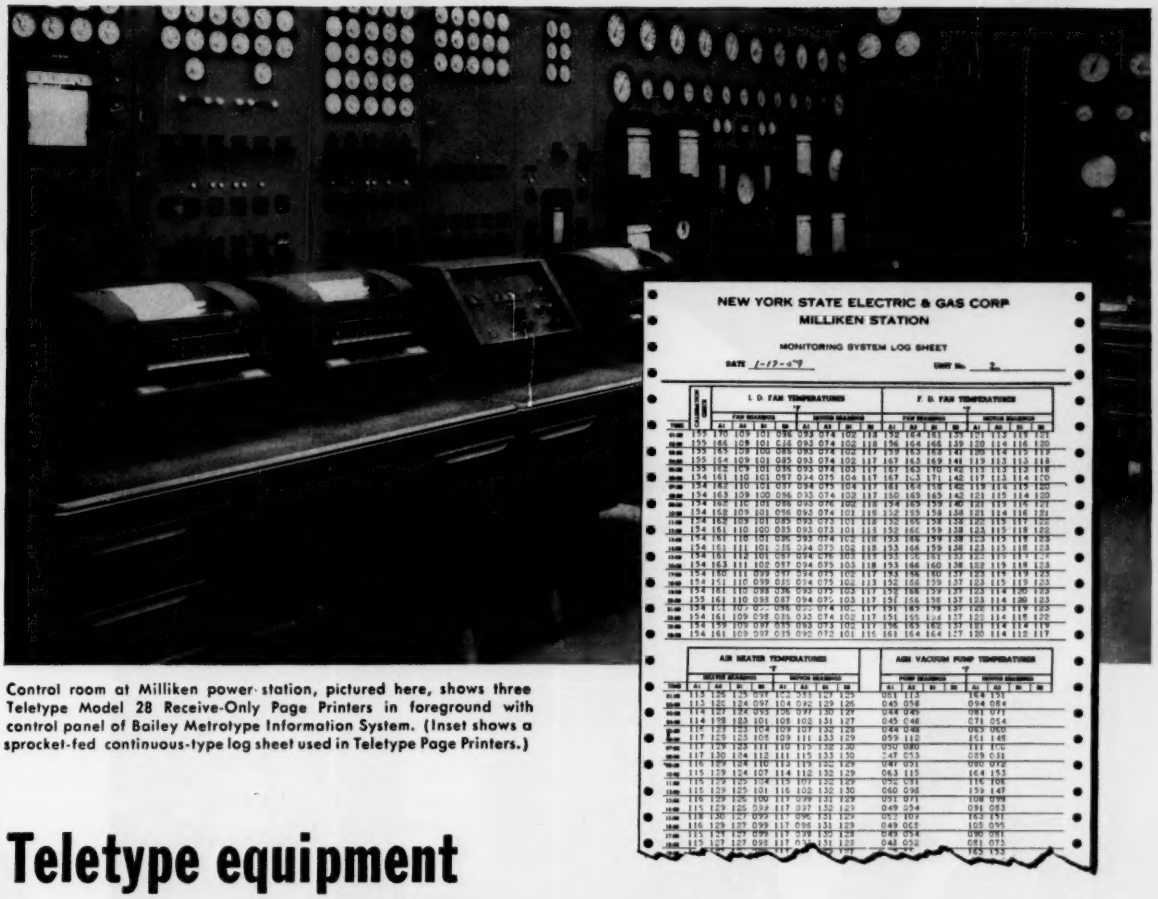


Swagelok®

the name that stands apart from all others in the field . . . outstanding and unique in concept, craftsmanship and leakproof performance

CRAWFORD FITTING COMPANY, 884 East 140th ST., CLEVELAND 10, OHIO • CRAWFORD FITTINGS (CANADA) LTD., NIAGARA FALLS, CANADA

Automatic read-out . . .



Control room at Milliken power station, pictured here, shows three Teletype Model 28 Receive-Only Page Printers in foreground with control panel of Bailey Metrotype Information System. (Inset shows a sprocket-fed continuous-type log sheet used in Teletype Page Printers.)

Teletype equipment monitors and records power station performance

New Model 28 Teletype Page Printers and Tape Punch equipment provide a continuous, dependable data processing facility for evaluating power station performance. This Teletype communication equipment is part of a Bailey Meter Company Metrotype® Information System installed recently at the Milliken power station of the New York State Electric & Gas Corporation, near Ithaca, New York.

This installation consists of two data systems:

1. A Monitoring System that continuously scans a total of 282 variables—temperatures of fan, motor and pump bearings; pressures of water and oil pumps, etc. Whenever readings exceed prescribed limits, system immediately reads and prints complete digital data of off-normal operation. In addition, complete readings are printed hourly.

2. A Performance System that scans 66 points once every hour, measures generator output, main steam flow, feedwater flow, temperatures, etc. All factors required to evaluate the station's performance are logged on the Teletype Printers. A Teletype Tape Punch also produces a perforated tape for IDP.

Robert Darke, Systems Division Manager, Bailey Meter, says, "Teletype equipment was chosen for this installation because of its flexibility and proven reliability. Design is simple and trouble-free, and the units are manufactured specifically for round-the-clock rather than intermittent service."

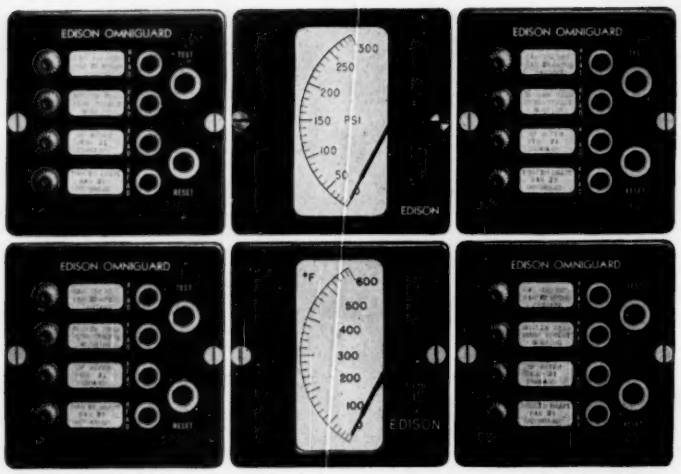
Teletype equipment will handle data for virtually any purpose in any industry. Signals may be serial or multi-wire. Signal medium may be local electrical circuit, telegraph or telephone circuit, or radio.

Why not find out how Teletype equipment can fit into your systems plan? Please write: Teletype Corporation, Dept. 23-K, 4100 Fullerton Ave., Chicago 39, Illinois.

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company* INC.

CIRCLE 58 ON READER-SERVICE CARD

← CIRCLE 57 ON READER-SERVICE CARD


EDISON OMNIGUARD
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EDISON
EDISON OMNIGUARD
TEST
RESET

GUARD ALL CRITICAL PRESSURES AND TEMPERATURES WITH . . .

THOMAS A. EDISON LOW-COST, OMNIGUARD WARNING SYSTEM

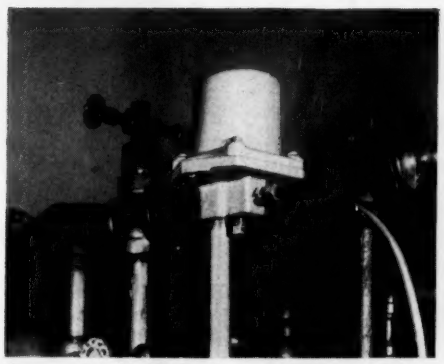
Here is a versatile, highly-reliable continuous warning and monitoring system. By simply pushing a button on this panel you obtain a reading of *key pressure* and *temperature* points throughout your plant. In addition, this system provides instantaneous warning when pressure or temperature deviates from pre-set limits.

PRESSURE With the Edison Omniguard system you can monitor gas, fluid or vapor pressure. Heart of the system is a rugged accurate pressure detector which converts pressure directly to electrical resistance—requires no milli-volt conversion—no amplifier. For pressures under 60 PSI a precision capsule is the sensing element. From 60 to 3000 PSI special bourdon tube elements are used.

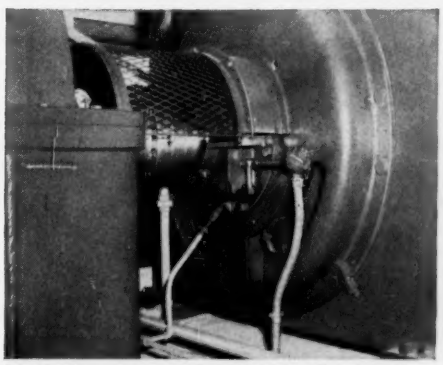
When pressure changes, resistance varies and this deviation is transmitted to the control panel. Units operate over ambient temperatures of 32° to 150°F. Control panels are available with a wide variety of scales and are equipped with both normally open and normally closed alarm contacts to operate any type of auxiliary device or to automatically shut down machinery or process.

TEMPERATURE Edison Omniguard also provides reliable protection from overheating. You can monitor the temperature of bearings, gases and liquids in critical equipments or processes. Reliable Edison Resistance Temperature Detectors have no moving parts and give instantaneous warning when limits are exceeded. Unlike other systems which only scan, Omniguard is continuously monitoring. You can obtain exact readings of temperatures in all parts of your plant from one central control panel.

For greater flexibility and reliability each detector circuit is completely independent. If one circuit is damaged, all other circuits remain "on guard." When changes or additions are required they can be accomplished quickly and easily.



Compact, reliable Resistance Pressure Detector transmits changes in pressure to central control panel.

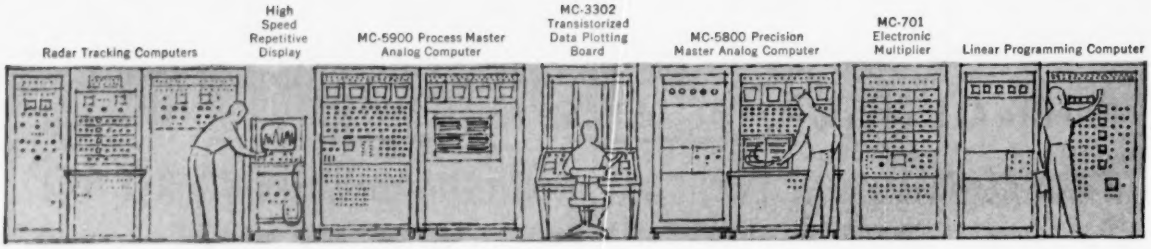


Rugged, accurate Resistance Temperature Detector guards against overheating of this motor bearing.

Thomas A. Edison Industries
INSTRUMENT DIVISION
24 LAKESIDE AVENUE, WEST ORANGE, N. J.

McGRAW EDISON

CIRCLE 59 ON READER-SERVICE CARD


Radar Tracking Computers
High Speed Repetitive Display
MC-5900 Process Master Analog Computer
MC-3302 Transistorized Data Plotting Board
MC-5800 Precision Master Analog Computer
MC-701 Electronic Multiplier
Linear Programming Computer

Some people can prove man and mouse are identical

It's all according to the points of similarity you choose. *Differences* are what really *prove* the superiority of man over mouse. Computers have differences, too. In fact, it's in these differences that the CSI-designed MC-5800 obsoletes every other Analog Computer. The best proof lies in

cold
hard
Specifications

- Exclusive dynamic memory makes automatic iterative solution of statistical or optimization problems a reality.
- Stable amplifier operation over the entire feed-back range from zero to infinity.
- Lowest amplifier grid-current $<10^{-9}$ ampere.
- Amplifiers provide lowest noise level output—less than one millivolt at unity gain.
- Amplifier frequency response—flat to 10,000 cps and only 3 db down at 28 kc.
- Real-time precision @ speeds to 60 solutions/sec.
- Exclusive electronic generators of the function of two-or-more variables may be programmed at patch-board in same time required for setup of single-variable generators.
- Will program 134 amplifiers, 30 electronic multipliers, 18 diode function generators, 2 time-delay generators, 8 relay amplifiers, and 6 servos from one 2128-hole patchboard.
- Highest performance electronic multiplier—flat to 10,000 cps and only 3 db down at 20 kc.
- Dynamic memory + high-speed quick-reset rep-op provide practical approach to solution of simultaneous partial differential equations.
- Dynamic memory with time-base accuracy of ± 10 μsec provides automatic parameter searching by iteration—an exclusive capability.
- Solution of problems with up to 15 amplifiers in closed loops.
- Plug-in dynamic components ease maintenance.
- Lowest computer cross-talk—rejection greater than 2,000 to 1.
- Selection of real-time, expanded-time or high-speed compressed-time without reprogramming.
- Passive networks stabilized at $<$ 1°C above room ambient—no oven required.
- EVERY SPECIFICATION IS GUARANTEED TO BE TRUE PERFORMANCE STANDARD—IN SUSTAINED OPERATION.
- Only diode function generators utilizing resistors, potentiometers, and diodes of equal quality to those in computing networks.
- Only diode function generators with individual hi-lo gain positions for *each* segment.
- Lowest function generator drift $<$ 5 mv/8 hrs.
- Lowest servo step-function overshoot—less than 1%.
- DC tachometer feedback on all servos.
- Complete control of all amplifiers, multipliers, dividers, and non-linear equipment at patchboard.
- Exclusive equipment-door packaging for free access and quick maintenance *without* shutdown.
- Insulated patchboard prevents costly shorting accidents.
- Power supplies eliminated from console—lowest, most stable operating temperatures—rise $<$ 3°C.
- Field expandable without mechanical rework or rewiring.

There are many more differences (over a hundred, in fact). Before you buy or lease your next analog computer, compare them all... and we think you'll agree with us when we say: The MC-5800 obsoletes every other analog computer made.

Computer Systems, Inc.—designers and manufacturers of the *highest* precision analog computers and computer accessories.

MAN IS A MOUSE

COMPUTER SYSTEMS, INC., 611 BROADWAY, NEW YORK 12, N. Y. • SP 7-4016
A Schlumberger Subsidiary • formerly Mid-Century Instrumatic Corp.

CIRCLE 60 ON READER-SERVICE CARD

CIRCLE 61 ON READER-SERVICE CARD →

Here you see a specially trained North American crew carefully loading a Burroughs computer. Professional crews such as these move electronic computers valued as high as three-quarters of a million dollars each.

Why Burroughs uses North American Van Lines for shipping electronic computers

"Because of North American's superior handling and delivery service, they are awarded a large portion of all shipments of our expensive and delicate electronic computers," asserts W. A. Reed, Traffic Manager, ElectroData Division, Burroughs Corporation.

He goes on to say, "North American's custom floor-to-floor delivery service is especially important in transporting items of this size and weight. Their crews have the necessary equipment and know-how to place the computers exactly where our customers desire. And by using North American's services we can ship our computers almost 100% assembled."

This is just one more example of how North American Van Lines' Kid-Glove handling and complete service all the way eliminates the many problems involved in shipping High Value Products.

Call your local North American agent and get the facts first hand. He'll be glad to talk with you about *your* product moving problems without obligation.

See "Championship Bridge" on TV

Watch North American's exciting new television show featuring Charles Goren and Alex Dreier every Sunday afternoon on ABC-TV—starting Oct. 18.

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In Canada, North American Van Lines Canada, Ltd., Pickering, Ontario . . . In Europe, North American Van Lines, Europe, GMBH, Mannheim, Germany

NEW high sensitivity ASHCROFT PNEUMATIC TRANSMITTERS

lower costs...reduce maintenance ...provide tighter control

Ashcroft Non-Indicating Pneumatic Transmitters are made in pressure and temperature types, each in regular and short span. Operation is on low-pressure air: output range, 3-15 psi or 3-27 psi.

These new transmitters are designed around (1) a powerful, efficient relay with sensitivity high enough to operate controllers, and (2) a simple, dual Bourdon tube motion-balance system. High sensitivity permits the use of narrowest proportional band settings on controllers and allows instant controller response to deviations from set point. With a shorter transmission lag, automatic corrective action starts before the deviation becomes critical.

In manual control systems, these new Ashcroft Transmitters (teamed with suitable receivers) make it practical to operate boilers at the most efficient level. In wet processing operations, fractionating columns yield a purer product. Highly suppressed Ashcroft Short Span Transmitters are so sensitive they can "judge" entire control loops and detect any errors in the system.

Basically a 6″ cube, lighter than most 8½″ pressure gauges, these climate-proof Ashcroft Transmitters are simple to install in cramped locations, are most readily accessible for adjusting or service. Calibration is extremely easy, with linearity checking entirely eliminated. Most parts in all types in the line are interchangeable. Ask your nearby Ashcroft Gauge Distributor about the lower initial costs and other savings that follow when you install Ashcroft Non-Indicating Pneumatic Transmitters. Send for Bulletin 361.

MANNING MAXWELL & MOORE INC. TRADE MARK

ASHCROFT PNEUMATIC TRANSMITTERS

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

CIRCLE 62 ON READER-SERVICE CARD

editorial

14th ISA Show

THE 14TH ANNUAL ISA Conference and Exhibit was held the week of Sept. 21, in Chicago. An exhibit reflects the state of the art as practiced in the field. The 1959 exhibit showed that the year was one of consolidation and refinement, with none of the "breakthroughs" (computer control, electronic controllers, loggers, etc.) characteristic of former years. Yet many significant new instruments and complete new lines of instruments deserve special mention:

1. The Telechrome Memotizer with 2 code drums offers both analog-to-digital conversion plus storage accumulation which opens up many new applications.

2. The Hankison Refrigifilter uses a compressor plus heat exchanger to obtain low-dew-point instrument air at unprecedented economies.

3. Industrial Process Engineers introduced a complete new line of process instrumentation that accepts any a-c or d-c signal, and includes controllers plus motor-operated valves as final operators.

4. Hagan new Series 2000 Kybernetes loggers feature solid-state construction; also new Hagan solid-state PowrMag analog-computer control elements feature patch-board interconnection.

5. Bailey Metrotype loggers also feature solid-state electronics. Trend to solid-state electronics was evident also in Baily electric control system. New Pyrotron radiation pyrometer with bolometer element also attracted much attention.

6. National Cash Register "Photochromism" recording technique is of special significance to field of recording; it uses dyes which can be changed between two color states by ultraviolet light—"optical switching." The NCR magnetic-rod storage elements also are of special interest to the computing field.

7. Sanborn x-y optical recorder has response to 100 cps; a motor-driven chart viewer was also introduced by Sanborn.

8. Gerber introduced a complete line of chart viewers plus scaling and linearizing accessories; also new x-y plotter.

9. Librascope x-y plotter features compactness, flexibility and speed.

10. Research, Inc., introduced the DataTrak function generator in which a probe follows the center of electrostatic field produced by two pencilled lines on a chart.

11. Both mass and magnetic flowmeters received great attention, particularly the GE massflowmeter, and the F&P and Foxboro magnetic flowmeters.

12. Foxboro introduced a line of solid-state computing elements (arithmetic); also new panel and console concepts.

13. Assembly Products' new CRMR (continuous-reading meter-relay) controls and reads independently.

14. Bristol introduced both new low-range infrared instrumentation and a new multipoint Dynamaster that can select any or all of up to 24 points.

The number of computers exhibited, both analog and digital, was less than in preceding years—but the emphasis in the technical sessions was on computers, particularly control computers; nearly ⅓ of all papers were on the subject of computers.

Computer Manufacturers On A Limb

One computer meeting held at the show started off with a deceptively simple idea which has mushroomed into an uncomfortable position for many computer manufacturers. The meeting was a follow-up meeting to one held by the AIEE Computer Systems Subcommittee at Boulder, Colo., May 20-22. Over 50 persons attended this followup meeting, held at the Panelit Cafeteria on the Friday evening after the ISA meeting closed. The 50 represented computer manufacturers and process users interested in computer control.

At the Boulder meeting, Ted Williams of Monsanto had offered to prepare a typical chemical problem for computer solution; the several computer manufacturers present offered to solve the problem. In this way both the differences between types and makes of computers could be evaluated.

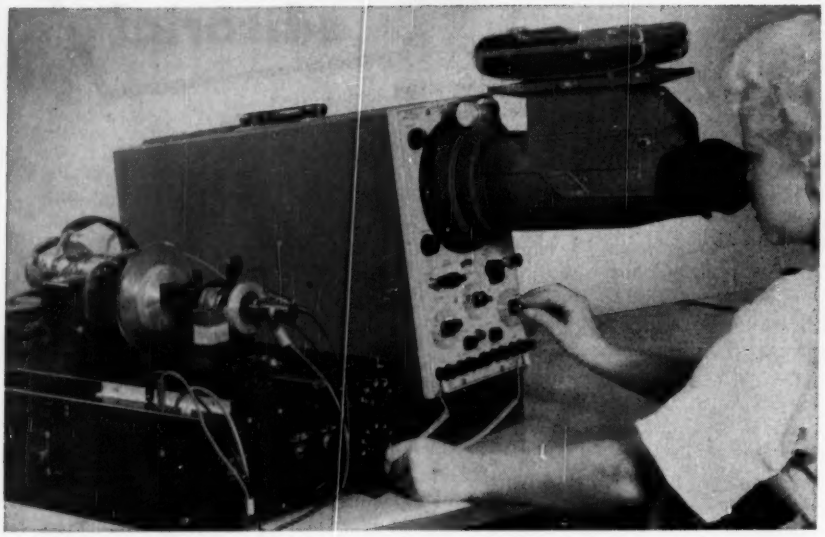
The idea appeared sound, and Williams developed a problem wherein a feed stream enters a stirred-tank reactor, then flows into a reactor cooler heat exchanger, then to a decanter and, finally, to a distillation column. Mr. Williams was kind enough to include all pertinent transfer characteristics.

Only later did the hidden dangers become apparent to the computer manufacturers, who have perhaps become accustomed to rushing into situations where angels tread carefully. First of all, the degree of satisfaction of the solution depends on the amount of engineering time spent on the problem; from $10,000 to $20,000 is a minimum. Second, it soon became apparent that the preliminary solutions do not prove economies (prices would have to be mentioned or else the problem becomes academic). Thirdly, some firms can solve the problem only by revealing developmental techniques or computers still under wraps.

None of this background will appear in the rash of sensational news that will be headlined in the technical press under the heading of "Computer Manufacturers Solve Process Problem." However, as of this moment, several computer manufacturers feel uncomfortably far out on a slender and expensive limb.

The problem is available to any computer manufacturer interested in the solution. All papers on the problem which are submitted to the AIEE Computer Systems subcommittee before Nov. 27 will be preprinted.

The solutions are scheduled for presentation at the Winter General Meeting, Control Computer Session, American Institute of Electrical Engineers, New York, Jan. 31-Feb. 5. We will keep our readers informed.



Use of oscilloscope-camera unit to record potentiometer characteristics. Servo-driven linearity tester compares master potentiometer with unit under test. (Courtesy Spectrol Electronics Corp.)

Oscilloscope-Camera Recorders

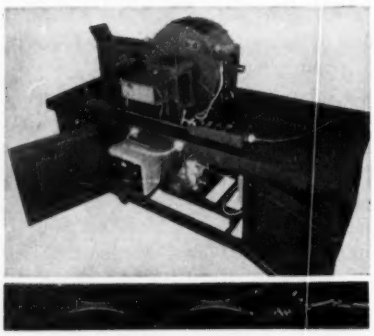


FIG. 1. AMINCO drum-type continuous-motion oscilloscope-recording systems. B shows typical record.

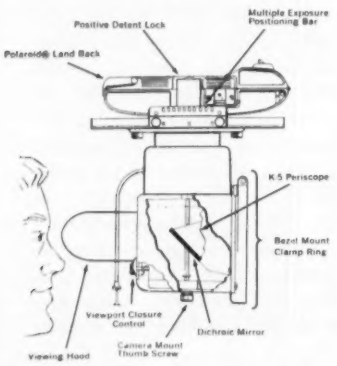


FIG. 2A. BEATTIE periscope assembly.

THE CATHODE-RAY-TUBE and camera recorder is the most popular technique for recording of signals above 5000 cps; it is useful to frequencies above 1000 megacycles. Available equipment includes units for single-frame exposure, continuous-film motion, or cine-film motion. Accessories include special lenses and high-speed films (with exposure index of 3000). This survey completes our previous discussion of galvanometer, light-beam, potentiometer, operations, pneumatic, and multi-styli recorders.

American Instrument Co.

In the Aminco high-speed oscillograph camera (Fig. 1) the film is on a drum. As it moves at the desired speed in readiness for recording, there is no need of synchronizing film movement to signal display (but shutter does need synchronized). Recordings are made by focusing the desired image on an endless strip of photo-sensitive material. The shutter can be opened at any time and closed when any preselected length of record has been taken.

The linear speed of the film is continuously variable from zero to 1735″/sec. A record 976″ (81′) long can be made on the strip of film. Lateral motion of the film drum along its axis of rotation takes place automatically whenever the shutter is open, producing a helical record. This prevents overlapping exposures. Time calibration marks (1-ms) are placed on the film adjacent to the record simultaneously and automatically to an accuracy of one per million.

Fig. 1B shows a record made of a 425-kc carrier, modulated approximately 70% by 500-cycle tone, and interrupted by a motor-driven switch 100 times per second. Drum speed was approximately 70 rpm (40% of maximum speed); timing mark interval is 1/500 second. Note the chatter of the switch contacts when they were opened. With a brighter screen on the oscilloscope, or with a spot of greater intensity, a higher drum speed can be used to expand the time axis. It is possible to resolve signals up to 80 kc or more; transients from 1 sec to 12 microsec can be recorded. A 5″ oscilloscope with a P-11 phosphor should be used for best results.

Beattie-Coleman

The Beattie line comprises a periscope unit with various camera attachments; also special "Radarscopes," cameras for reading the output of an IBM 704, and a "Fluorotron" for mass x-ray tests.

The Beattie Oscillotron Model K-5 recorder, provides a group of interchangeable components for recording with single-frame, continuous-motion, and Polaroid-Land cameras.

The basic component is the periscope assembly (Fig. 2A), which attaches to the oscilloscope with a split clamp ring. A hooded view port is provided in the front of the periscope assembly. The CRT image can be viewed directly through a dichroic mirror, permitting binocular vision.

The following cameras can be mounted on the periscope assembly:

1. Beattie 60-second camera with a Polaroid-Land camera back. Up to 10 traces can be recorded on a single frame, up to 80 traces on a single roll. Standard camera is equipped with a Wollensak Raptar f/1.9 lens with #3 Alphax shutter (1 sec to 1/100th second, time and bulb), and ground-glass focusing panel. A small Polaroid-Land camera back, useful for economical 60-second CRT recording uses the smaller Polaroid-Land film. Minification is approximately 2:1

2. 35-mm Oscillotron camera, comprising a modified Beattie Varitron and featuring an automatic electric 35-mm magazine that accepts up to 100′ of film. The camera is actuated electrically on demand or through an intervalometer, and can be triggered by the event being recorded. Remote control and simultaneous recording of displays on a number of oscilloscopes is accomplished easily. Standard equipment includes 38-mm f/1.9 Wollensak lens in focusing mount, 1/50-sec tripping or holding shutter, and ground-glass focusing panel.

3. A continuous-motion film magazine that records variable-intensity or vertically-variable-position CRT spots. The film is advanced continuously across an open aperture at discrete lineal speeds of 1/16, 1/8, 1/4, 1/2, 1, 2, 4 and 8 inches/sec by interchangeable external gears. Available in 35- and 70-mm models, 115-volt 50-60-cycle ac or 28-volt dc.

The KD-5 Oscillotron system (Fig. 2B) permits simultaneous recording of CRT phenomena and appropriate identifying data.

Beattie also has a new direct-view Oscillotron (Fig. 2C) that permits the user to view the cathode-ray tube in a direct line of sight while recording.

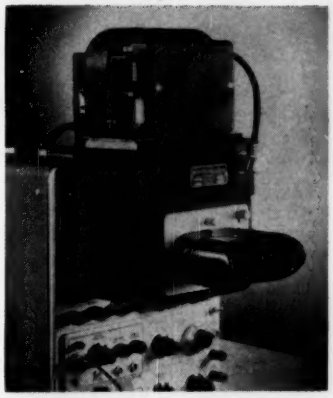


FIG. 2B. BEATTIE KD-5 Oscillotron with continuous-motion film magazine mounted for simultaneous recording of CRT phenomena and appropriate identifying data.

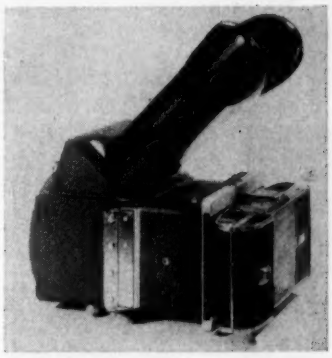


FIG. 2C. DIRECT VIEW Oscillotron.

FIG. 3A. B & W Model 224 drum camera.

Beckman & Whitley

Beckman & Whitley makes two continuous-writing drum cameras for oscilloscope trace recording. Model 224 (Fig. 3A) provides a continuous streak image on 35-mm film approximately 50″ long. Also approximately 70 pictures 17 x 25 mm when used with the Model 189 framing camera. Sweep rate is 120 meters per sec. Time resolution is 1.2×10^{-6} sec at f/2.8.

Model 307 (Fig. 3B) provides a continuous streak image on 35-mm film approximately 15″ long. Sweep

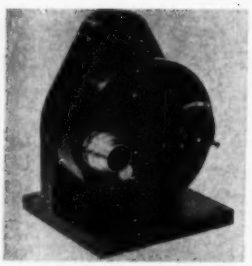
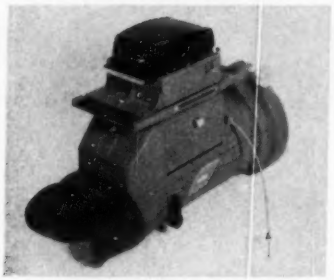
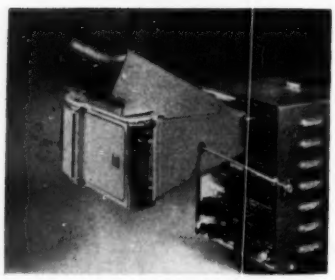


FIG. 3B. B & W Model 307 streak recorder.

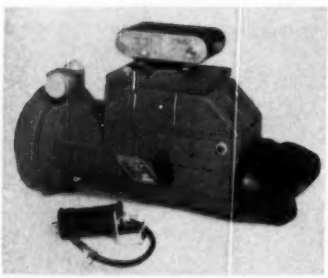


A

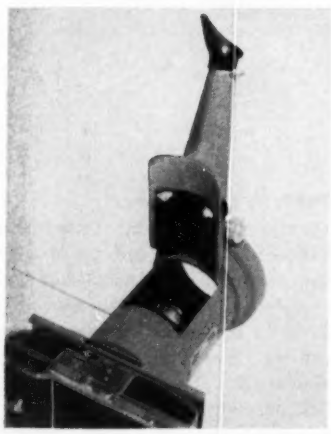


B

FIG. 4. DUMONT Type 299 for multiple, separate exposures; B shows Type 399 direct-view; C shows Type 352 camera and scope that can be triggered simultaneously and automatically; D shows Type 353 direct-view with 1 to 1 object-to-image ratio.



C



D

rate is 300 meters per sec. Time resolution is 5×10^{-7} sec at f/2.0. Auxiliary equipment includes an automatic film loading and unloading casette, and a drum speed indicator.

DuMont

DuMont Oscilloscope Recording Cameras for 3″ and 5″ oscilloscopes include single-frame, continuous motion or automatic frame-advance units, on (1) standard film emulsions, (2) roll, cut or strip film, or (3) transparent or opaque Polaroid film.

The Type 299 (Fig. 4, A) uses a Graflex camera with a variety of backs available for use with many styles of conventional film, 120 roll or cut. It is useful in general-purpose recording from 5″ oscilloscopes.

The Type 302 uses a Polaroid camera back and is interchangeable with the Type 299. In both, a data card provides picture identification. A dichroic beam-splitter permits viewing of waveform, while recording, without danger of fogging film, and multiple, separate exposures per frame are possible. Three detent stops position the back for three equally-spaced exposures, while a scale and pointer arrangement assists in positioning the back accurately for more than three exposures per frame. Image reduction is 2¼:1.

The Type 321-A camera provides for recording any 5″ oscilloscope display, either through continuous moving-film or single-frame exposures. Facilities for remote control are provided. An f/1.5, 51-mm seven-element Wollensak coated lens ensures high-resolution images, without distortion, regardless of aperture setting. An f/2.8 lens also is available. The film transport system holds up to 400′ of film and provides 16 selectable film speeds ranging from 0.8 to 3600″/min for full-length recordings. Two additional speeds of 5400 and 10,800″/min are available for short-length recordings. Timing markers are developed by a flashing argon glow lamp behind a small aperture in contact with the film.

The Type 339 Polaroid camera (Fig. 4, B) provides for recording from 3″ oscilloscopes. Features include f/2.8, 50-mm lens, Alphax shutter, binocular viewing, quick connect/disconnect bezel fixtures.

The Type 352 (Fig. 4, C) is a high-speed, automatic camera for photographing from 5″ oscilloscopes on 35-mm film. It is capable of advancing film frames rapidly and automatically. With the shutter solenoid supplied it can be operated remotely. This camera is fitted with a spring-wound automatic film advance capable of transporting from one to 17 frames of film with one winding. It can take a sequence of pictures automatically as long as the shutter release is held down—within the limits of the spring motor. An accessory spring booster motor extends the available automatic film advance up to 50 frames with one winding. The rate at which sequence exposures can be made depends on the shutter setting; for example, at the 1/500-second setting, 6 photographs may be made in one second. In general, the maximum writing rate capable of being photographed is about 75″/usec using a P11 screen on a CRT operating at 9 kv.

The Type 353 Polaroid 1:1 camera (Fig. 4, D) produces image-sized, (2⅞″ x 3¾″) non-reversed records

of traces from any standard 5″ oscilloscope. A sliding detent back and rotatable barrel also permit multiple exposures per frame on either the long or short film dimension. Monocular viewing permits direct viewing of the trace simultaneous with recording without danger of fogging the film under normal lighting conditions. A light-tight access door may be left open to allow direct viewing of traces during set-up procedures. Either transparent Polaroid film (Type 46L) or direct print Polaroid film (Type 42 or 44) in eight-exposure rolls can be used.

Electro-Medical Laboratory

The Electro-Medical oscilloscope camera is shown in Fig. 5 with the Garceau Electromyograph.

The camera uses standard 100′ reels of 35-mm film. There is a simple manual shutter, no iris, and an f/2.1 coated lens, which can be focused to get full film coverage from CR tubes 2″ to 21″ in diameter. Film speed in standard model is adjustable from about 1 to 10″/sec; film motion is continuous.

No hood is required for recording in subdued daylight or incandescent light with plain (not panchromatic) film and P11 phospor tube. 10-kc traces can be recorded.

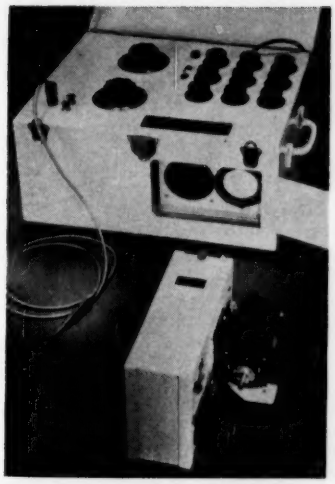


FIG. 5. ELECTRO-MEDICAL camera can be positioned to view various-sized CRT screens.

Electronic Tube Corp.

The ETC SM-100 camera is designed to fit all standard 5″ bezels. It records on either 35-mm film or paper (perforated or unperforated) at a rate of from ½″ to 12,000″/min. Film capacity is 400′ or 1000′. A binocular viewer allows continuous viewing in subdued light during recording. The camera mounts in either a horizontal or vertical position and can be used with sloping-face console-type scopes. Object-to-image ratio is 4.5:1; timing marks are provided, and data card can be illuminated.

ETC Model SM-200 (Fig. 6) uses the Polaroid-Land camera back, f/1.9 Wollensak lens and Alphax shutter in a special mounting for fast single-frame prints and slides.

Using Polaroid Type 42 film, the SM-200 can record traces running at a sweep speed of 1/10 microsecond per centimeter at a repetition rate of 10 cps. The new Polaroid film Type 47 will record even faster traces.

FIG. 6. ETC Model SM-200 Camera.

Fairchild Camera & Instrument

The Fairchild-Polaroid oscilloscope camera Model F-286 (Fig. 7) provides two exposures on each print through a 2-position quick-shift mechanism. Also, by shifting traces on the CR tube, multiple exposures can be placed on each half of the film. Camera is equipped with a 75-mm f/1.9 Wollensak Oscillo-Anastigmat lens and #3 Alphax shutter having speeds of 1 sec to 1/100 sec, "time" and "bulb." Image size is one-half of scope image. Model F-296 has same lens and shutter as Model F286 but provides 1:1 image ratio (single image on each frame).

Using the latest Polaroid film, traces with speeds up to 300 cm per microsecond can be recorded by either model. Also, traces with speed up to 8000 cm per microsecond can be recorded by pre-fogging the film.

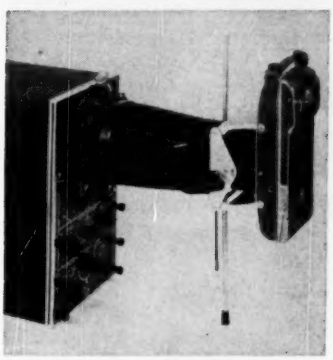


FIG. 7. FAIRCHILD-Polaroid Camera.

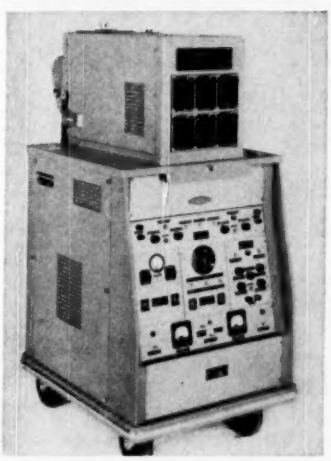


FIG. 8. HAMILTON SC-16B has six cathode-ray-tube units; records 200,000 cps.

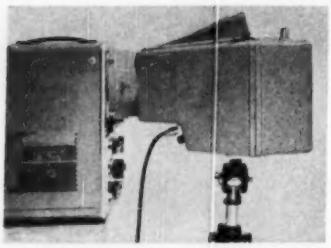


FIG. 9. H-H Type C6 camera.

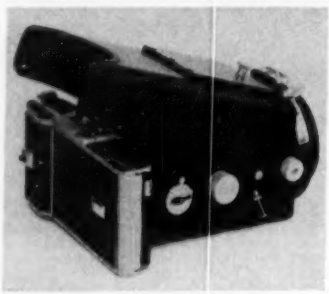
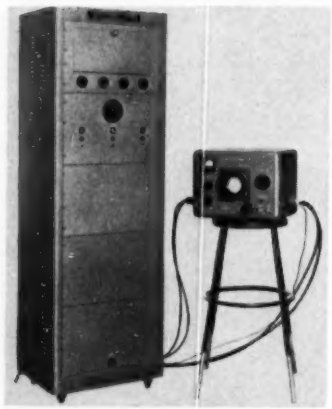
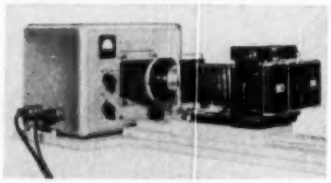


FIG. 10. HEWLETT-PACKARD Model 196A permits lateral positioning of lens.

FIG. 11. IBM 740 computer output device can display data points at a rate better than 7,000 per second.



A



B

FIG. 12. LIBRASCOPE Model C Image Converter Camera can photograph millimicrosecond transients.

Hamilton-Hathaway

Hathaway Instrument Division of Hamilton-Watch Co. offers the SC-16B cathode-ray multi-channel recording oscillograph for recording transient and periodic phenomena of high frequency (Fig. 8). Frequency range is 0 to 200,000 cps; writing speed is up to 5,000,000″/sec. Drum-type magazines permit chart speeds up to 6,000″/sec. Continuous-drive magazines use either recording paper or 35-mm film at speeds to 600″/sec.

Each of the six recording elements is a complete CRT and amplifier unit; interchangeable lens stages can present the 6 traces (or less) on 6″ or 35-mm chart.

The oscilloscope camera Type C6 (Fig. 9) is a portable, continuous-drive camera using commercially-available, 6″ photo-sensitive paper or film for recording signals on 5″ oscilloscopes. An adjustable-height tripod has a universal head that permits recording in either a horizontal or vertical position. In the vertical position, the sweep of the scope can be used to achieve high-speed writing rates. Two types of interchangeable gears afford low and high paper speed ranges. The mechanical sweep mode of operation uses the regular continuous action of the chart, while a second mode of operation is provided by the mechanical sweep combined with the internal sweep of the scope. Typical writing rates are up to 350,000″/sec on paper with a P5 tube surface.

Lens is 50 mm, f/1.8, 90-mm focal length. Image-to-object ratio is 1:1, ±10%. Record material is standard 6″-wide commercially-available photo-sensitive paper or film, 100′ standard-base length or 150′ thin-base length. Paper speeds are 5″ to 275″ per second with high-speed gears (continuously variable), ¼″ to 17″ per second with low-speed gears (continuously variable).

Hewlett-Packard

The Hewlett-Packard Model 196A oscilloscope camera (Fig. 10) has an object-to-image ratio of 1 to 0.9 to show full 10-cm graticule width. Lens adjustments are made through an access port while the camera is in position. A standard camera bellows simplifies multiple-exposure procedures. A knob moves the lens through 11 detented positions while the camera back remains fixed. Second knob shown is the development timer. A quick-connect clamp provides support.

International Business Machines

IBM's 740 CRT recorder (Fig. 11) is used with the 704 and 709 data processing system. The shape of a cam can be computed, and the shape, together with successive positions of the cam, can be displayed and photographed for a permanent record. The 740 also can be programmed to display alphabetic characters, geometric shapes, engineering symbols, graphs, etc.

The 740 contains a 7″ cathode-ray-tube characterized by a raster consisting of 1,024 positions for the ordinate (Y) deflection and 1,024 positions for the abscissa (X) deflection. The tube has a persistence of several microseconds and has unusually precise deflection characteristics. Its position stability is better

than 0.1% and a minimum error of 0.5% positional accuracy can be expected. A camera using commercially available 35-mm film is standard equipment. The camera is equipped with a removable film magazine having a capacity of 100′ of perforated 35-mm film. Film frame change is under calculator control and requires less than 50 microseconds to initiate.

Librascope

The Librascope Model C Image Converter Camera (Fig. 12) photographs transient phenomena in the millimicrosecond region. The camera, designed around an image converter tube, is electrostatically focused and deflected. Exposure times to 10 millimicroseconds are possible.

The event can trigger the camera within millimicroseconds. Exposure time is adjustable. Each frame is independently controlled and continuously variable. Exposure time is 0.05 to 1.0 microsecond; frame spacing is 0.5 to 50 microseconds; number of frames can be 1 to 5 as selected.

Display also can be recorded by Polaroid camera mounted on special housing using fast Polaroid film. The image-converter tube holds the signal long enough to reproduce the signal on the Polaroid film.

Vought

Vought Company offers a large line of photographic data recording devices for all film sizes with frame rates from pulse operation (time-lapse) to over 1000 frames per second.

The VDR-4B holds 100′ of film on daylight-loading reels and can be provided with basic cine′ rates of 8, 16, or 24 frames per sec. Pulse rate can be determined by operator up to a maximum of 10 frames per second. Other versions are the VDR-42B (Fig. 13) that holds 200′ and the VDR-44TM (external magazine).

Optional features available include, timing light, crosshair aperture reticles, fiducial marks, boresights, etc.

Special oscilloscope recorders include a high-speed streak unit which records deviations in the "X" axis against a recorded time base, and a slow-speed unit which permits time exposures as long as 15 minutes with sequencing for the next operation in less than one second. Beam splitters provide various percentages of reflection and transmission depending on customer requirements. All of the pulse data recorders (time-lapse recorders) can be used to record CRT data.

Wollensak

Wollensak's line of Fastax cameras include continuous-motion oscilloscope streak recorders, full-frame and split-frame cameras for various film sizes and speeds, and time-lapse cameras.

Continuous-motion cameras have 100′ to 400′ film capacity and can record streak images from 4-200′/sec.

Models WF-14 and WF-15 (Fig. 14) are 400′ combination motion-picture and oscillographic-streak cameras. Oscillographic streak range is from 4′ to 200′ per second. The WF-14 takes 350 to 9,000 pictures per second; the WF-15 takes 700 to 18,000 pictures per second.

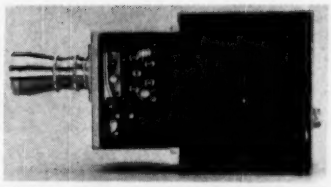


FIG. 13. VOUGHT VDR-42B with 200′ of film on daylight-loading spool.

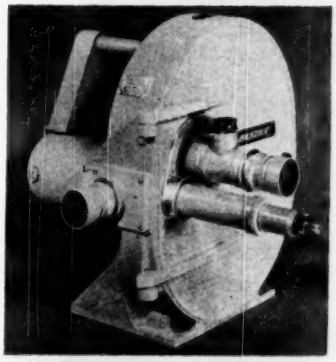


FIG. 14. WOLLENSAK combination motion picture and oscillographic camera.

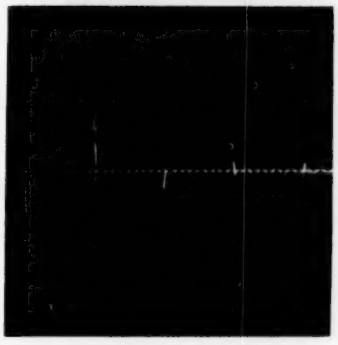


FIG. 15. RECORD of 450-MC damped wave taken with Tektronix 517A oscilloscope, H-P 196A camera set at f/1.9, Type 47 Polaroid film.

Accessories

Polaroid Fast Film

Polaroid Corporation has introduced a new film (Type 47) so fast (daylight exposure index of 3000) that it can be used to record single CRO transients with rise times less than one millimicrosecond—transients of such high speed that they are invisible to the eye.

Fig. 15 shows a record of a single-shot 450-Mc damped sine wave. A measurement of the fastest visible part of the trace indicates a writing rate of over 3000 cm per microsecond.

The new Type 47 Polaroid Land Picture Roll will fit in any standard Polaroid Land Camera. Best results for recording fast transients are obtained on the blue P11 phosphor. With special prefogging techniques, further increases in maximum writing rates are possible, exceeding 8000 cm per microsecond.

Wollensak Oscillo Raptar Lens

The new Wollensak Oscillo Raptar six-element anastigmat lens is designed especially for oscilloscope recording to provide a distortion-free, curvature-free anastigmat lens with fine resolution and sharp corner definition. The 3″-focus, f/1.9 lens is made in two types—one for 1:0.9 reduction and one for 1:0.5 reduction for 3″ x 4″ format. It generally is supplied in a #3 Alphax shutter, with optional synchronization.

Pressure Recorders

This view of pneumatic-signal recorders continues our series on recorders. It includes static-pressure, differential-pressure and receiver types.

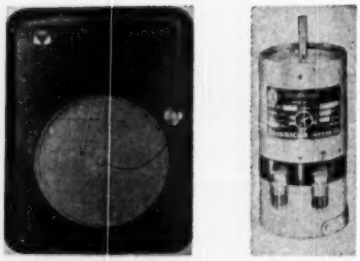
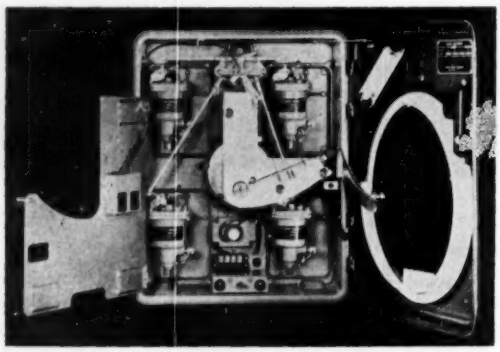


FIG. 1. AMERICAN METER pressure recorder and Gasclock.



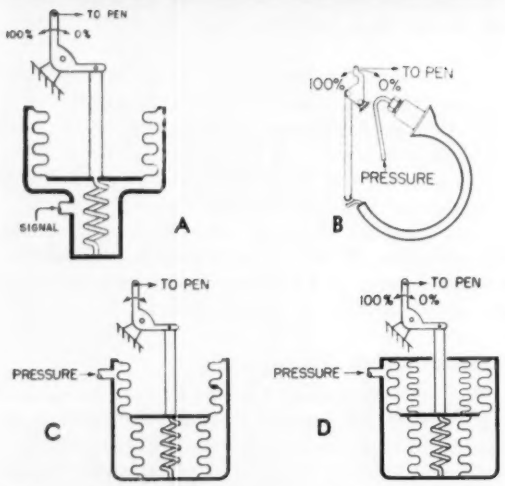


FIG. 2. BAILEY four-pen pneumatic receiver recorder with four Class 8 bellows transducers. Bottom shows cross-section of Bailey transducers for various pressure ranges and measurements.

MOST PRESSURE RECEIVERS use a bellows or a bourdon tube as a pressure-to-position transducer. The thrust, displacement and simplicity of bellows make them popular for positioning recorder pens and for other low-pressure service. A bourdon-tube transducer usually is selected for intermediate and high pressures, and when lower pressures need only be indicated.

The following pressure recorders and indicators are available commercially. Most have accessories available for control, but this description applies only to the recording units.

American Meter Co.

American pressure recorders (Fig. 1) for one or two pens are available in ranges up to 10,000 psig. Bellows elements are used for ranges below 50 psig. Helical spring elements of Ambrac are used for ranges up to 500 psig. Stainless steel is used for higher ranges and a Ni-Span element is available for 0-1000 psi.

Mechanical or electric chart drives provide 24-hr or 7-day rotation.

American also supplies a "Gasclock" air- or gas-powered instrument timing unit. Normal gas or air consumption is 5 cu ft/hr at 5 psi. Rotation is 2 rpm. Accuracy is ± 1 minute per day and is not affected by a ±20% variation in supply pressure. Mechanism is self-starting and provides 4 inch-ounce torque.

Bailey Meter Co.

The Bailey pneumatic receiver (Fig. 2, top) drives a recording pen or recording pen and integrator with factory calibrated accuracy within ±0.5% of chart range span at ambient temperatures between 40°F and 140°F. Standard SAMA signal ranges are 3-15 psig or 3-27 psig. Recorder has up to four pens fed by one-year sealed plastic ink sacs.

Fig. 2 shows operation of four basic transducers available as plug-in elements. A shows Class 8D for recording direct-connected pressure in standard ranges of 0-10, 15, 20, 25, 30, 35 psig; and 0-20, 25, 30 35″ Hg. B shows bourdon tube element with a maximum range of 0 to 7500 psig. C shows gage pressure (Class 81) or vacuum transducer (Class 82) with ranges of 30″ Hg to 25 psig and 0 to 30″ Hg. D shows Class 84 absolute-pressure transducer for 0 to 20 psia. Bellows units work against Iso-Elastic springs.

Barton

Barton Model 202 recorder (Fig. 3) converts differential pressure into a shaft rotation that is taken through a torque tube to a linkage attached to a standard inking pen and a 12″ meter chart. The patented rupture-proof bellows is formed of selected stainless-steel sheet that is stamped into wafers and seam welded. An extra bellows attached to the high-pressure side of the bellows unit assembly takes up expansions and contractions of the fill liquid within. Iso-Elastic spring assemblies balance the differential pressure applied to the unit. They are available in interchangeable units with ranges from 0-20″ W.C. to 0-50 psi. External accessable pulsation dampening by-pass the fill liquid through a restriction. Depending on the service, the meter is self venting or self draining due to the arrangement of the pressure port connections.

Response speed is approximately 100 milliseconds undamped. Signals up to 3 cps can be recorded with practically no attenuation.

Helical pressure elements are available in a variety of materials including brass, beryllium copper and stainless steel for static pressure ranges from 30″ MV (mercury vacuum) to 10,000 psi.

Chart rotation can be 96 seconds to 30 days; drive can be electric or spring.

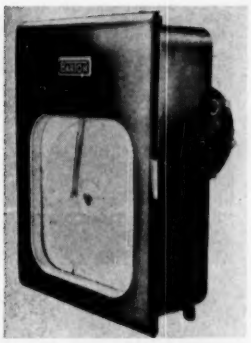


FIG. 3. BARTON differential-pressure recorder.

Bristol

Bristol's 500 Series receiver recorders (Fig. 4) are designed for pressure ranges from 0-6 mm mercury absolute up to 0-10,000 psi and higher, and including vacuum and compound ranges. Round charts are 8″ or 12″ electric or spring-driven. Up to four pens available in 12″ size.

A Model 28 vertical strip chart recorder also is available for the same ranges. Chart drive is electric; speeds are from $\frac{3}{4}$″ per minute to 12″ per hour. A Model 44 4″ round chart recorder also is available.

Capsular and bourdon tube elements are available in brass, beryllium copper, phosphor bronze, Ni-Span C, or 316 stainless sheet.

Features include pulsation dampening; over-range protection and temperature compensation are available.

Accuracy is ±0.5%. Response speed is 90% of full scale in less than 0.1 sec.

Bristol's Series 650 Metagraphic plug-in one- and two-pen pneumatic recording receivers and indicators include 39 models. All cases are the same size (Fig. 5), occupying a 5″ x 5$\frac{1}{8}$″ panel area; record is a 3″ horizontal strip chart. All have plug-in interchangeability and can be removed from the front of the panel. Self-sealing sockets permit making and breaking connections without disturbance to the system.

The instruments receive a 3-15-psi air-pressure signal, but can be furnished to order for 3-18 psi, 5-25 psi, 3-27 psi, and 0-30 psi signals. The recording chassis uses multiple-diaphragm measuring elements; the indicating models use a bourdon pressure element; all include pulsation dampers to smooth out sudden surges in the signal. Accuracy is ±0.5% full scale.

Chart drives may be electric or pneumatic, and are interchangeable. Pneumatic drives provide speeds of 1 and 2 inches/hour. Electric chart drives provide speeds of 1, 2, or 3 inches/hour; also speeds of 1, 2, or 3 inches/minute are available.

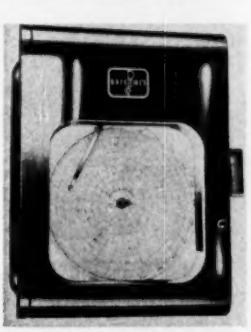


FIG. 4. BRISTOL 500 Series round-chart model.

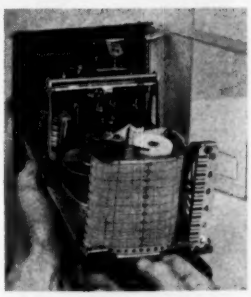


FIG. 5. BRISTOL Series 650 receiver recorder can be slid forward for span and zero adjustment and chart service.

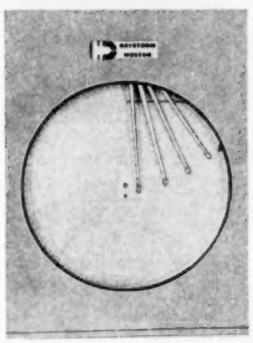


FIG. 6. DAYSTROM-WESTON pressure recorder; receiver recorder is similar with up to three pens.

Attachments available include a chart cut-off, a pneumatic integrator, and a ratio control system. Control models also are available.

Daystrom-Weston

The Daystrom-Weston pressure recorders Model 7711 (single pen) and Model 7712 (multi-pen) have 12″ chart, 4.75″ pen travel (Fig. 6). Standard chart drives are electric or hand wound. The recorders cover

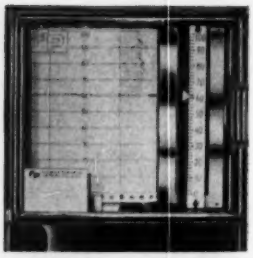
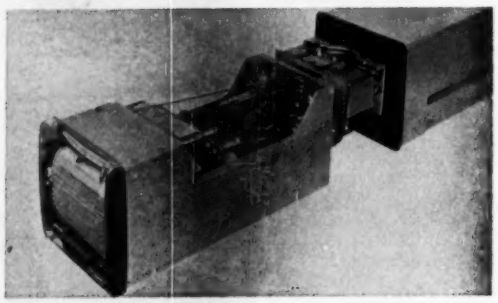


FIG. 7. FISCHER & PORTER Series 1200 recorder.



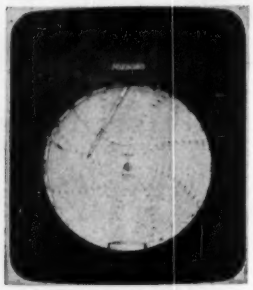


FIG. 8. FOXBORO M/54 receiver recorder (top); Model 42 (left) can have up to four pens.

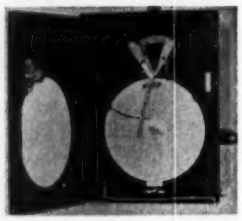


FIG. 9. GENERAL CONTROLS J-200 Series.

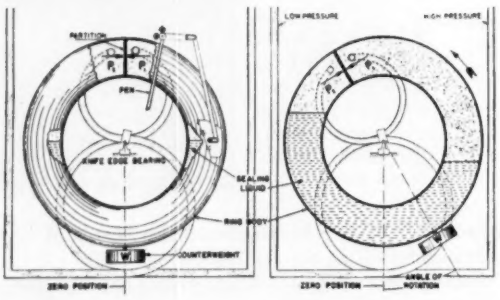


FIG. 10. HAGAN ring-balance operation. Difference in pressure against partition rotates ring. 6000 Series is shown at left.

the range of 30″ of vacuum to 7500 psig. Accurately calibrated bellows or bourdon springs serve as the actuating element according to the pressure range. Absolute pressure ranges are from 0-760 mm mercury.

Daystrom-Weston Pneumatic Receivers operate on a 3-15 psig signal. An accurately calibrated bellows serves as the actuating element. One to three pens are available.

Fischer & Porter

Fischer & Porter Series 1102 pneumatic receivers accept a 3-15 psig signal and record on a 12″ circular chart. Transducer is a bellows; chart drive can be spring or electric providing one revolution every 24 hours. Accuracy is ±1% full scale; repeatability is ±0.5%; sensitivity is ±0.2%.

The Series 1200 miniature recorders (Fig. 7) receive a 3-15 psi signal and record on a 4″ strip chart. Transducer is a 3″ Ni-Span C capsule; chart drive is electric. Accuracy, repeatability and sensitivity are same as for Series 1102.

Foxboro

The Foxboro Consotrol line includes the Model 53 and Model 54 pull-out, two-pen receiver recorders (Fig. 8). A mercury bottle switch and automatic interlock provide non-arcing protection when the electric chart drive assembly is withdrawn.

Accuracy is 0.5%; response speed is 0.4 sec full scale.

Range bellows receives 3-15 psi signal. Damping is adjustable from the front. Thirty-day chart has 4″ scale width. Speed is ¾″/hr. with ½-hr time divisions. Drive can be synchronous motor or pneumatic impulse type.

Foxboro's line also includes a Model 42 receiver recorder (Fig. 9). Response time is 0.4 sec, full scale. The element is a bronze bellows which takes a 3-15 psi input range. Recorder is available with up to four pens and uses mechanical or electric chart drive with choice of speeds and rotations. Accuracy is 0.5%.

General Controls

Industrial Controls Div. of General Controls offers a J-200 Series of pressure recorders for ranges up to 10,000 psi, including receiver recorders for 3-15 psi pressure signals (Fig. 9).

C-type bourdon tubes are made from phosphor bronze, steel and stainless steel.

Chart size can be 6″ dia or 8″ dia. Drive can be hand wound or electric for 24-hr or 7-day rotation. Accuracy is 1%.

Hagan

Hagan's pressure measuring devices cover a minimum full-scale range of 0.20″ W. C. to a maximum of 3000 psig. The 400-Series instruments and the 4000-Series instruments are used for recording relatively low static pressures—up to 100″ W. C. for the 400-series

and 560″ W. C. (approximately 20 psig) for the 4000-Series instruments. The 400-Series instruments is available with a 10″ dia chart; the 4000 Series instrument is available with a 12″ chart.

Both instruments use the Ring-Balance principle (Fig. 10). A hollow ring half filled with sealing fluid is the primary sensing element. The ring is balanced on a precision knife-edge fulcrum that permits rotation about its axis. The static pressure or differential pressure is applied to the ring through flexible tubing connectors and acts on an integral ring baffle to produce a torque. Rotation of the ring develops a counter torque due to a preselected range weight attached at the bottom of the ring. Thus ring rotation is proportional to the measured pressure. The pen is positioned proportional to the ring motion. These units measure either static pressure or differential pressure. Absolute pressure also can be measured by connecting one side to a vacuum source.

The calibration of the 400 and 4000 Series instruments can be checked by weights supplied with the instruments. Response time for these units varies from less than 1 sec to approximately 15 sec, depending on range and fluid measured.

The 6000-Series recording instruments have a 12″ circular chart and are suitable for measuring static pressures from 50″ W. C. to 3000 psig or absolute-pressure from 5 psia to 200 psia.

Pressure measurements up to 400 psi are made by relatively large-area bellows elements; pressures above these values are measured by spiral elements.

Hays

Hays Model 771 Universal Recorder (Fig. 11) can provide from one to four continuous records of pneumatic signals. Calibration adjustments are accessible on chart plate. 4.4-second full-scale pen travel is available, chart can be 1, 8 and 24 hr or 8-day rotation.

Direct-acting pressure receivers are bellows or bourdon springs. For 5 to 60 psig element is a brass bellows; 65 to 3000 psig uses brass, steel or alloy steel bourdon springs; 5 to 15 psig vacuum uses brass bellows.

Model 221 directly-actuated draft and low-pressure recorder is used to record air and gas pressure, draft, differential pressure, and flow. A slack diaphragm measuring element mounted on the recorder chart plate is directly connected to the measured variable. Suitable springs oppose the diaphragm movement calibrating the instrument. The pen indicates the value of the measured variable on a circular chart. Model 221 is used to record pressure or draft down to 0.2″ water, full scale.

Sensitivity is better than 0.2% of full scale range. Two-pen recording can be provided to record two variables. Chart drive is 24-hour spring wound or 110- or 220-volt Telechron electric clock. Minimum full-scale range is 0 to 0.2″ water; maximum full scale range is 0 to 120″ water. Accuracy is 2% full-scale range.

Manning, Maxwell & Moore

Ashcroft Recording Receiver Duragauges (Fig. 12) have a standard air pressure range 3 to 15 psi. Other ranges include 2-14, 2-15, 3-18, 5-25 psi. Bellows units are used.

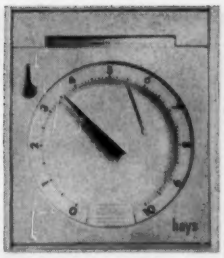


FIG. 11. HAYS Model 771.

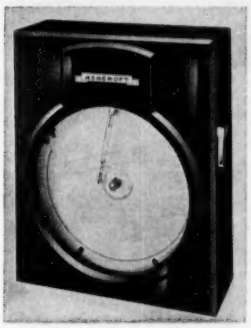


FIG. 12. MANNING, MAXWELL & MOORE Ashcroft Duragauge.

Accuracy is ±0.5% of scale. Actuation is by self-draining bellows. Round 10″ charts for 3⅝″ pen travel are driven by a 24-hour (or other time period) spring-wound or electric chart drive. Features include damping, rupture-proof bellows, overload stops.

The recording receiver is available in all vacuum and pressure ranges.

Minneapolis-Honeywell

Minneapolis-Honeywell's Series 702X circular-chart receiver recorders (Fig. 13) use flat spiral or spring-and-bellows measuring elements. Chart drive has tapered chart positioning stud. Charts are automatically in time when replaced. Hub has friction clutch for initial setting. Chart drive is synchronous motor with starting switch. Standard chart speed is 24 hours per revolution. Other speeds are optional.

One-, two- and three-pen recorders are available with optional air purging, damping assembly (for special applications), auxiliary door nameplate, and internal chart or scale illumination.

M-H Tel-O-Set receiver recorders, series 723X (Fig. 13,B) use a spring-and-bellows receiving element linked to the pen or pointer as shown in Fig. 13, C.

Air pressure pushes up on the bellows (B), compressing the calibrated spring. The bellows pushes up on the center rod (C), which lifts the horizontal arm (D) and, through a Roberts linkage (E), the pen or pointer (F). Pressure range is 3-15 psi. All adjustments and servicing can be done from the front of the panel. Zero and span can be adjusted by a screwdriver when chassis is partly withdrawn from case. Linearity requires no attention.

Charts are 3″ strip type marked in accordance with the measured variable. Chart reroll and daily tearoff is provided on all recorders. 60′ length is sufficient for 30 days at 1″/hour speed. Chart drive is electric—

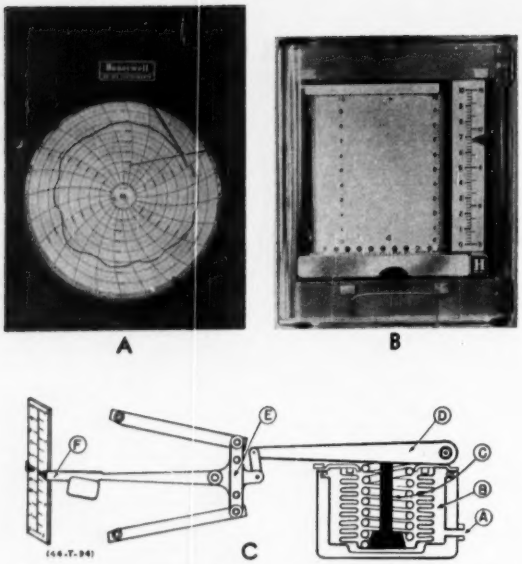


FIG. 13. MINNEAPOLIS-HONEYWELL Series 702X receiver recorder (top). Top right shows M-H Tel-O-Set; bottom shows linkage.

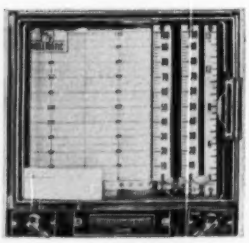


FIG. 14. MOORE PRODUCTS single-station cascade control recorder.

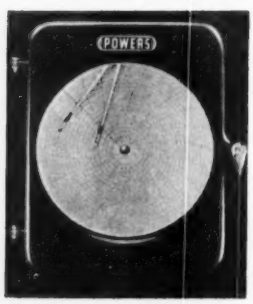


FIG. 15. POWERS Series 100 two-pen recorder.

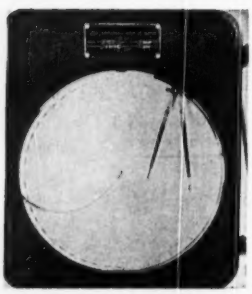


FIG. 16. ROCKWELL differential and static pressure recorder.

115 volts, 50 or 60 cycles a-c. Speeds are 1, 2, or 4" per hour. Air pressure supply of 20 psi is required for pneumatic chart drive. Pneumatic pulse chart speed is 1"/hour.

Moore Products

Moore Models 5310, 5311 and 5320 pneumatic recorders are of the same plug-in style as the recorder-controller shown in Fig. 14. Pressure transducer is a 3" Ni-Span C capsule. Range is 3 to 15 psi. The 4"-wide chart reveals a 14-hr record when chassis is withdrawn partially. Chart drive is electric or air; standard speed is 7/8" per hour.

Accuracy is ±0.5% full scale; response speed is 1 sec full scale.

Powers Regulator

The Powers Series 100 pressure measuring system (Fig. 15) uses a bourdon spiral to measure pressures between 0 and 500 psi; minimum span is 75 psi. Accuracy is ±1% full scale. Chart is 12" dia with 5" pen travel. Spring-wound and electric chart drives are available.

Rockwell Manufacturing

The Rockwell 201 orifice meter (Fig. 16) is a differential and static recording instrument. The differential ranges are available from 0 to 5" through 0 to 400" of water. Static pressure ranges are available to 400 psi. Vacuum and reverse units are also available.

Also available is a Combined Record Gauge. This unit will record the pressures on positive-displacement type meters and ranges up to 1000 psi. The gauge also records cycles which indicate when the volumes being measured were consumed. The index records a standard uncorrected cubic foot record of the volume.

The Rockwell Type "T" Emcorector unit provides a multiple of recorded data: Along with the uncorrected volume, the integrating mechanism provides the corrected volume of the measured gas. The recording device graphically records the line pressure and when the volume was consumed.

Taylor

The heart of the new Transcope recorder is the Servomatic motor (Fig. 17), essentially a power piston with a built-in positioner. These servos are sensitive to changes of less than 0.1% in the pneumatic signals and have 150 times the pen-positioning power of the conventional bellows-type actuator.

The 3-15 psi input signal is received at the input capsule of the servo and positions the baffle against the nozzle. Air is metered to the nozzle through the orifice. As the baffle approaches the nozzle, pressure builds up in the nozzle chamber and over the servo's diaphragm motor. This pressure forces the spring-loaded diaphragm downward, causing the main drive shaft to rotate. A calibrated range spring extends as the shaft rotates, and repositions the baffle, achieving a force-balance condition.

The rotary motion of the shaft and attached pulley is transmitted to the pen assembly by a specially-heat-

treated polyester cable, locked to the pulley. Pneumatic or electric alarms can be attached to the opposite end of the shaft. Zero, range, and linearity adjustments are at the top of the servo assembly. Accuracy is within 0.5%. Maximum response time is 3 seconds full scale.

In addition to the Transcope line, the Transet recording receiver is available in twelve different forms, all with 3-15 psi receiver bellows with 0.5% accuracy and adjustable damping. The 3″-wide strip-chart record displays three hours of visible record. The indicating pointer is located in the center of a dual scale and provides both set point indication and reducing valve output indication.

There also is available the conventional circular-chart Fulscope recorders.

U. S. Gauge

First model in a redesigned line of USG circular chart recorders for pressure is shown in Fig. 18. Recorder can have up to 4 pens. Measuring elements include a bronze bellows for 0-5 to 0-30, 3-15 psi and 0-30″ vacuum. A phosphor-bronze spiral bourdon tube handles 0-15 to 0-8000 psi, 0-30″ vac., compound ranges. A beryllium copper spiral bourdon tube is for 0-1000 to 0-20,000 psi. A Type 316 stainless steel spiral bourdon tube handles 0-30 to 5-5000 psi.

Drive can be either 24-hour spring drive or 115-volt 60-cycle synchronous motor. Other winds, voltages and frequencies are available.

Accuracy is within ±1% of total span. Line also includes 6″-dia single-pen and 9″-dia two-pen recorders.

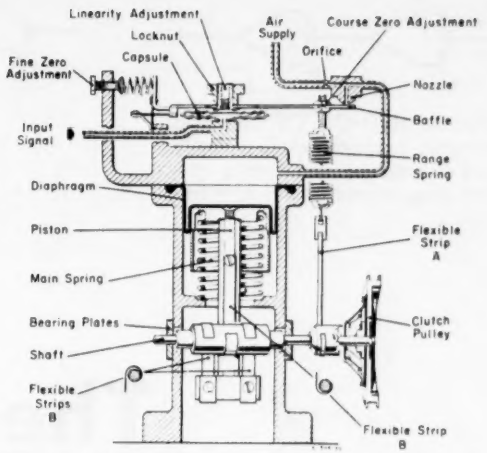


FIG. 17. TAYLOR Servomatic motor uses input signal to vary air pressure on diaphram motor.

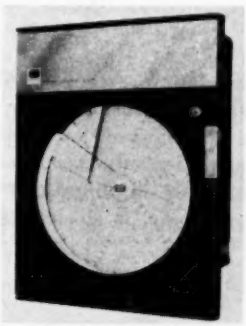


FIG. 18. U. S. GAUGE recorder with 12″-dia chart.

Ceramics do the Special Jobs

INDUSTRIAL CERAMICS now embrace a wide diversity of materials and can be fabricated in an array of sizes and shapes. Heat resistance of up to about 4200°F, combined with thermal shock resistance can be attained readily (Figs. 1 and 2); excellent dielectric properties are obtained easily. But ceramics also provide (1) controlled porosity for predetermined absorption, (2) absence of porosity to limit absorption, (3) design flexibility and miniaturization, and (4) strength and hardness.

Chemical purity, perhaps, has not received sufficient attention. New high-purity grades of Alumina, for instance, contain as little as 8 parts per million of certain undesirable elements. Similarly, extremely pure grades of zirconia are now available which are almost entirely free of Hafnium (0.008%) and which contain as little as 5 to 8 parts per million of Cadmium or Boron.

Photos courtesy Saxonburg Ceramics, Inc.

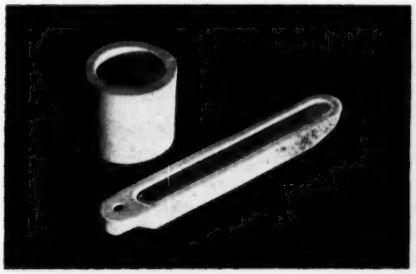


FIG. 1. HEAT SHOCK is the outstanding requirement for chemical boats and crucibles whose temperatures might rise from room temperature to 3200°F within 45 seconds. These high-purity Zirconium Silicate boats will withstand 3500°F and resist penetration by stainless or silicon steel slags.

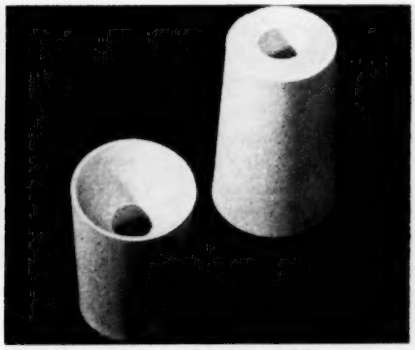


FIG. 2. STABILIZED ZIRCONIA pouring nozzles must withstand 4200°F without softening. For 3000°F temperatures, refractory alumina or zirconium silicate is also used.

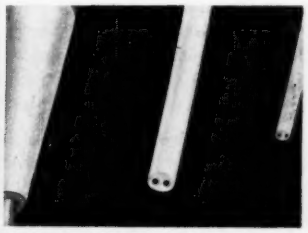


FIG. 3. ULTRA-THIN ceramic thermocouple tubing is contrasted here with the thinlead of an automatic pencil. This product is produced as small as 0.030″ O.D. with two holes each only 0.006″ I.D. The material is extra-high-purity magnesia.

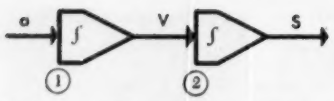


FIG. 1. METHOD OF obtaining voltages proportional to velocity and distance traveled, from a voltage proportional to the acceleration.

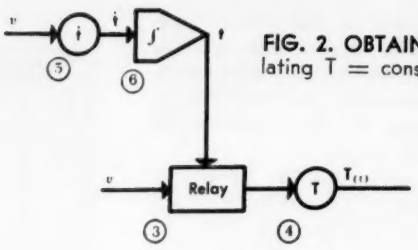


FIG. 2. OBTAINING a voltage for simulating T = constant for a given interval.

The EDA

Simulation is the use of electronic analog and/or digital computers to determine the dynamic behavior of physical systems. Simulation can be mechanized on direct-analog, electronic differential analyzer, digital differential analyzer, general-purpose digital, special-purpose computer, or combinations of these. Here are the specific advantages and limitations of electronic differential analyzers—plus some cost factors.

JOHN MCLEOD
Convair-Astronautics

ELECTRONIC DIFFERENTIAL ANALYZERS have unique advantages which have not been as well publicized as some of their limitations. The most important advantage stems from the analogy between the electronic model and the physical system under study, the characteristic which justifies the popular name "*analog computer.*" As the analog can be made as detailed or as general as the problem warrants, and as parameters can be changed with the turn of a dial, an engineer working with an analog computer can observe the effect of changes as they are made and thus acquire a "feel" for his problem which he could not get from any number of numerical solutions. For this reason it has been said that analog computers would earn their keep even if they never "solved" problem one!

The Analog Computer

An analog computer is a group of "operational amplifiers" and related equipment suitable for solving sets of ordinary, simultaneous, nonlinear differential equations. Operational amplifiers are capable of accepting several voltage inputs, multiplying them by constant integers, and summing and/or integrating the result with respect to time. They are usually associated in an analog computer with a stable reference voltage and power supply, a number of potentiometers for "multiplying" by fractions, multipliers for multiplying by variables, resolvers for changing coordinate systems, function generators for introducing empirical relations, switches, relays, etc., for controlling and monitoring operation and, finally, recorders and plotting boards to record results. All of these components operate on voltages, which are made analogous to the variables of the physical system. In the general-purpose analog computer the components are connected together by means of patch-cords.

A Typical Problem

Let us assume that we wish to study the effect of changing various parameters of a short-range rocket in order to arrive at an optimum design. Let us assume a constant weight and a constant thrust for a definite duration of time. Then we start with the basic equation based on Newtons second law of motion:

$$F = ma \qquad (1)$$

and solve for the highest derivative:

$$a = F/m \qquad (2)$$

where a = acceleration along the flight path; F = summation of longitudinal forces acting on the rocket; m = total mass of rocket.

If the thrust, T, and the aerodynamic drag D are large compared to the weight of the rocket, the total longitudinal force, F, on the rocket can be expressed:

$$F = T + D \qquad (3)$$

We have said that the thrust will be a constant, T, until the cut-off time t_c, and then it will be zero so the thrust as a function of time will be:

$$T(t) = T \ (0<t<t_c)$$
$$= 0 \ (t \geqslant t_c) \qquad (4)$$

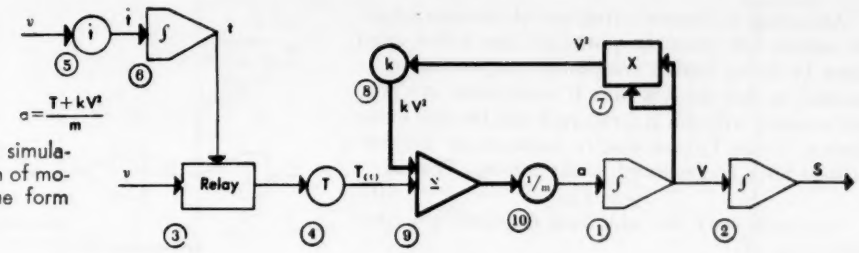


FIG. 3. COMPLETE simulation of basic equation of motion ($F = ma$) in the form $a = (T + kV^2)/m$.

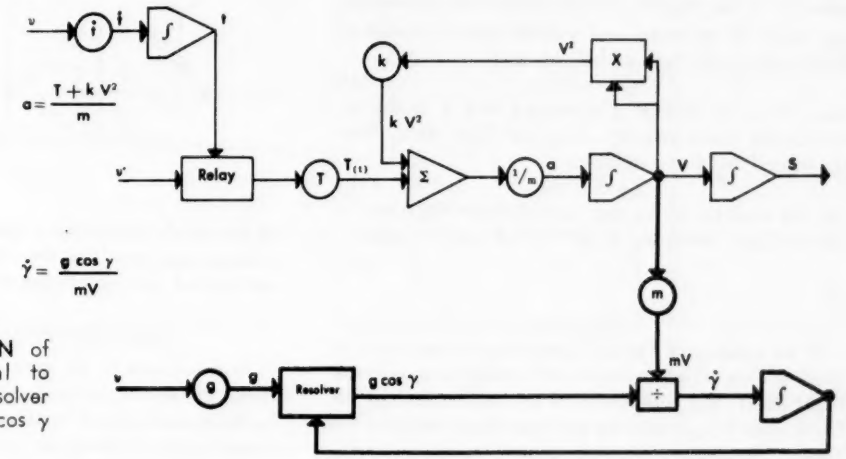


FIG. 4. GENERATION of voltage proportional to flight-path angle γ. Resolver gives g sin γ and g cos γ from γ and g inputs.

We know that the drag force is

$$D = -\tfrac{1}{2}\rho V^2 A C_D \qquad (5)$$

where ρ = atmospheric density; V = velocity of rocket along the flight path; A = equivalent frontal area of rocket; C_D = drag coefficient.

If this is a short-range subsonic rocket, we will not be far wrong if we let

$$-\tfrac{1}{2}\rho A C_D = k \qquad (6)$$

Substituting (6) in (5) yields

$$D = kV^2 \qquad (7)$$

Substituting (7) in (3) and (3) in (2) reduces the complete longitudinal equation to:

$$a = (T + kV^2)/m$$

The straightforward mechanization of this problem on an analog computer is shown in Figs. 1, 2 and 3. Basic to the procedure is the assumption that the voltage analogous to the value of the highest order derivative (in this case, a) can be made available when needed. As shown in Fig. 1 we can integrate this voltage (a) with respect to time in integrating amplifier (1) and obtain a voltage analogous to the rocket velocity V. We can then integrate that voltage out of amplifier (2), and get a voltage which will be proportional to the distance, S, traveled along the flight path.

What do we need to generate the required voltage analogous to a?

The equation $a = (T + kV^2)/m$ says that one thing we need is T as a function of time. The voltage proportional to T must be constant for a specified interval and then go to zero. This is accomplished as shown in Fig. 2. Two voltages are obtained from the computer reference voltage v. One is supplied through a relay (3) to the scale-factor potentiometer (4), which adjusts it to a value proportional the rocket thrust T. To operate the relay the reference voltage v is adjusted by means of potentiometer (5) to some convenient value, $\dot{t}$, and then integrated in amplifier (6), to give a voltage, t, which increases linearly with time. The normally-closed relay (3) is set to open when $t = t_c$, which operation cuts off the simulated thrust.

We also need a voltage proportional to kV^2. This can be obtained as shown in Fig. 3, which combines the circuits of Figs. 1 and 2 with new circuits (heavy lines) multiplying V (which we already have available from amplifier 1) by itself in multiplier (7), to produce V^2. Multiplying this by k in pot (8) generates the required voltage. Now adding this to T in the summing amplifier (9), and multiplying by 1/m in pot 10, gives $(T + kV^2)/m$, which is equal to a. So our assumption that (a) could be made available was justified, and the computer is connected to solve the simple nonlinear second-order differential equation $a = (T + kV^2)/m$, and integrate this twice to get missile velocity and position.

Trajectory Simulation

We have referred to velocity *along the flight-path*. Usually, however, we are interested in the *shape* of the trajectory. This requires that we know the direction of the flight-path—i.e., the flight-path angle as a function of time.

According to Newton's first law of motion, a body in motion will travel in a straight line unless acted upon by forces having components perpendicular, or normal, to that straight line. If such forces are present a missile will turn at a rate such that the sum of the normal forces F_N are exactly balanced by the centrifigal force F_C generated by the turning. That is,

$$F_N = F_C \tag{8}$$

In missile work two additional equations are taken advantage of:

$$\omega = \dot{\gamma} \tag{9}$$

where ω is the angular velocity about the instantaneous center of curvature and $\dot{\gamma}$ is the rate of change of flight path angle, both in radians, and

$$\omega r = V \tag{10}$$

where r is the radius of curvature and V is the instantanous linear velocity along the flight path. Then the centrifugal force equation

$$F_C = \omega^2 rm \tag{11}$$

can be used to derive the normal force equation by substitutions according to (8) (9) & (10) to give:

$$F_N = \dot{\gamma} Vm \tag{12}$$

or

$$\dot{\gamma} = F_N/Vm \tag{13}$$

If we consider a "no-lift" trajectory (one in which there are no aerodynamic forces acting normal to the flight-path), the component of gravity normal to the flight path (F_{Ng}) will be the only force turning the rocket. That is:

$$F_N = F_{Ng} \tag{14}$$

But:

$$F_{Ng} = g\cos\gamma \tag{15}$$

By substituting (14) and (15) in (13) we can write $\dot{\gamma} = g\cos\gamma/mV$ and mechanize it to find γ by adding the computing components shown in heavy lines in Fig. 4.

If an x-y plot of the trajectory is desired, it can be obtained by adding computing components as shown in heavy lines in Fig. 5 to mechanize the relationships $V_x = V\cos\gamma$, and $V_y = V\sin\gamma$, and integrating them to obtain and record X and Y.

Refinements

If we wish to examine the rocket performance in more detail we can make our simulation more detailed. If the rocket weight is *not* small compared to the thrust and drag, we can add a term $g\sin\gamma$ (which is already available from the resolver which produced $g\cos\gamma$) to the acceleration to take care of the effect of the rocket weight.

If the rocket is a high-speed missile so that C_D changes substantially with velocity, and long range so that ρ changes considerably with altitude, then the simplification $k = -\frac{1}{2}\rho AC_D$ is no longer valid and the drag force ($D = \frac{1}{2}\rho V^2 AC_D$) must be generated by adding the function generators and mutipliers as shown, and resetting pot (5) to take care of the only remaining constants, ½ and A. These changes are shown in heavy lines in Fig. 6.

Computing elements can be added easily to take care of other effects of interest, such as the change in mass as fuel is consumed, the change in the gravitational force as space vehicles leave this world, etc. The value

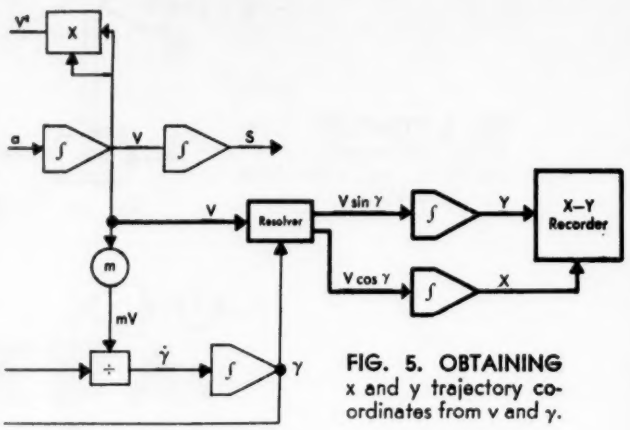


FIG. 5. OBTAINING x and y trajectory coordinates from v and γ.

of any of the variables in the system (represented by voltages generated in the computer) can be plotted out against time or against other variables.

Multi-dimensional Problems

In this problem we have only considered the two-dimensional translational equations in the pitch-plane. In three-dimensional systems including rotational and cross-coupling effects, the mechanization can and does get complicated. Nevertheless this simple example illustrates one of the most important characteristics of the analog computer: An engineer can build with computer components, just as with system components, a system as simple or as complex as required for his purpose.

Advantages of Simulation by EDA

1. Changes in design parameters can be simulated by twisting a dial, or at most by changing a function in a function generator. In our example the effect of increasing thrust can be observed by increasing the setting of pot (4). Or the effect of aerodynamic design can be studied by changing the C_D function generator.

2. Changes in basic design can be simulated by changing patch cords to change the basic model. Perhaps we would like to know what would happen if we put some fins on the rocket in our example. This would require additional computer components to generate voltages proportional to the lift and drag forces created by the fins. These voltages would then be plugged into the $\dot{\gamma}$ and acceleration summing junctions respectively.

3. The engineer is forced to become intimately familiar with the operation of the physical system. It has been said that this alone would justify the use of an analog computer, even if it never actually "solved" a single problem.

4. The speed with which the computer can operate is usually an advantage. The speed results because all elements operate in "parallel" with respect to time. This not only saves operating time to solve a problem, but also allows the computer to operate in "real" time —i.e., in a one-to-one time relationship with the physi-

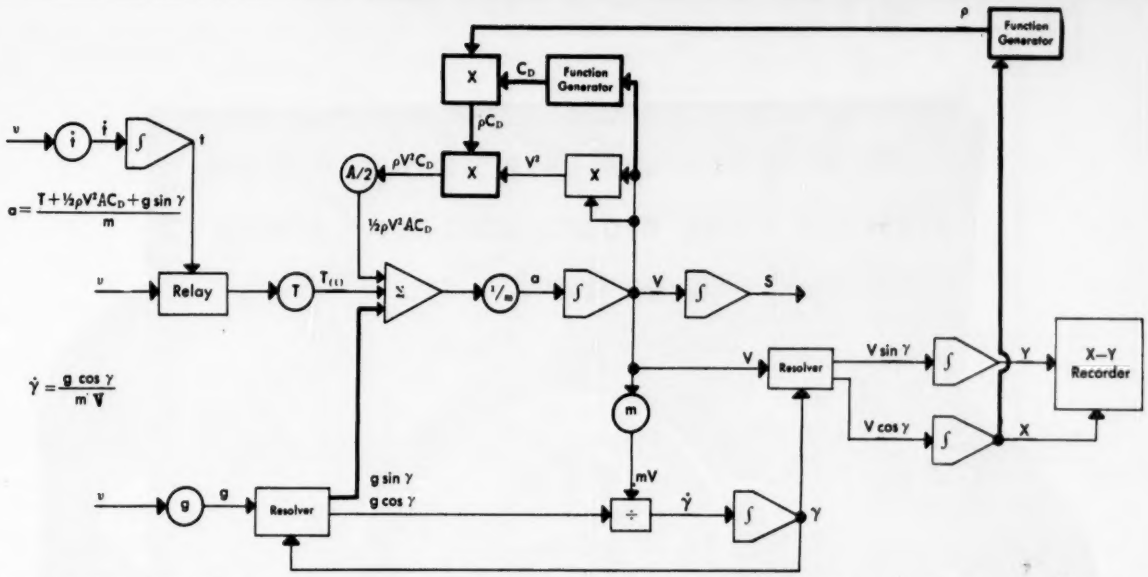


FIG. 6. REFINEMENTS for examining effect of rocket weight changes in the drag coefficient with velocity, and atmospheric density with altitude.

cal system, which is necessary if actual system components are involved in the simulation.

5. The "language" the EDA speaks is often an advantage. Most inputs represent quantities in nature which, in general, are analog rather than discrete. Therefore no "translation" at the input is necessary. At the other end, the output is usually for human consumption, and as most engineers are human (?) and prefer graphs to numbers for the analysis of dynamic behavior, they understand the computer.

Limitations

A limitation talked about most is lack of accuracy. This is overemphasized. True, although most individual components will produce errors of only about one part in a thousand; these can build up in a complex problem to 5% or more. However, analog computers are usually used to simulate hardware whose performance is not predictable or measurable with accuracy that great. Furthermore, computer errors build up in the simulation in the same way that hardware and measurement errors do in the physical system. Thus, for simulation the analog computer is usually as accurate as it has to be.

A more serious difficulty is that of answering the question "How do you know you are right?" Qualified answers may be obtained by:

1. **Component checks**
2. **Static checks**
3. **Numerical checks**
4. **Comparison with the physical system**
5. **Engineering judgment**
6. **Clairvoyance.**

Usually some combination of the foregoing is used to build up the necessary degree of confidence. However, checking is still a problem and is recognized as such by the computer manufacturers who have made, and are making, progress in alleviating it.

One inherent characteristic which may or may not be a disadvantage, depending on the problem, is the inability of the electronic differential analyzer to integrate with respect to a variable other than time. In simulating most physical systems this is no handicap because it is only necessary to integrate with respect to time. In other cases the problem can be set up in such a way as to represent a variable in the system other than time by time in the simulation.

Cost

A rule of thumb is that, on the average, three operational amplifiers will be used for every order of the set of differential equations being mechanized. (This can vary from about one to ten or more for problems involving a large amount of algebra.) Unless you define the type of problems to be solved, three per degree is about as good a guess as can be made.

The price of an analog computer will vary from about $700* per amplifier to perhaps ten times that amount. The lower figure includes a minimum of auxiliary equipment as contrasted to the more elaborate computers with a complete complement of nonlinear, input-output, and special checkout equipment. The cost of the average installation will probably run between $2,000 and $3,000 per amplifier, or from $5,000 to $10,000 per order of the set of equations. (Circumstances can alter these figures by an order of magnitude in either direction.)

If you are willing and able to spend the money, can you simulate systems of any complexity? No! The reliability of an electronic differential analyzer, as with anything else, goes down with the complexity of the mechanization. Thus a point is reached when the equipment simply cannot be made to give useful answers. This point depends on the problem, the equipment, the operator, and the maintenance man.

Some people are cowed by the mere idea of an electronic computer while others can successfully manage complexes of several hundred amplifiers and auxiliary equipment. Moral: pick your operators and maintenance men with the same care you choose your equipment—and pay them accordingly!

*Some unstabilized ones are even less.

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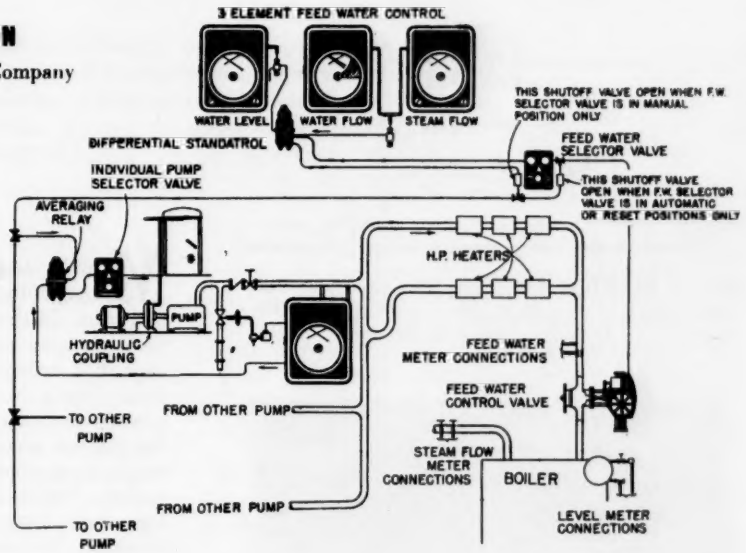
THREE-ELEMENT FEEDWATER CONTROL VIA PUMP AND VALVE



Where a constant-speed pump is used in a feedwater line to a steam generator, the throttling valve must be nearly closed at low loads, dissipating and wasting energies of hundreds of horsepower. A variable-speed hydraulic coupling can be used with the pump, and the coupling controlled by the conventional 3-element feedwater control system. In other words, the 3-element system can control the pump rather than the feedwater valve, or it can control both.

In one early system, the 3-element system was used to control the feedwater valve, and the *pressure differential* across the feedwater valve was used to control the pump.

A subsequent installation (shown) employed a similar system, but consideration was given to the possibility of using the pump speed to control the feedwater flow, and only using the feedwater valve for low load operations or under emergency conditions. However, since no experience was available, it was considered prudent to make the installation in such a way that the feedwater valve could be used in parallel, as a means of securing precise and reliable operation.

As illustrated, the three-element control system is connected to a Hand-Automatic Selector Valve, the output of which goes (1) to the feedwater control valve and (2) to the individual boiler feed pumps driven by variable speed couplings. Selector valves (Hand-Automatic) are also provided for each individual pump speed control.

When the main Selector Valve is in the Hand position, the three-element feedwater control governs the speed of the pumps—providing the Selector Valves for the individual pumps are on Automatic—and the feedwater valve can be open wide, introducing a minimum pressure loss into the system. When the main Selector Valve is in the Automatic position, the three-element feedwater control regulates the feedwater valve and, simultaneously, the speed of the pumps. This provides a complete range of control, and offers the reliability of a proven system operating the valve in the feedwater line.

Experience with this installation proved that reliable feedwater control over a relatively broad range could be obtained by control on the pumps only and, theoretically, no feedwater control valve is required. However, the valve is usually included; it can be left in a wide open position during all normal operating conditions. This valve control has considerable value in placing the boiler on the line, and during periods of abnormal pump operation.

Based on this experience, the three-element feedwater control system was applied only to the pump speed, and only remote, manual operation provided for the feedwater valve. The results of this installation lead to the possibility of eliminating the feed valve entirely from the system, and many installations have been made in this manner.

In systems of this type, the pressure at the discharge of the pump is at a minimum, and experience indicates that a feedwater control valve is often needed to increase feedwater pressure, either for operation of the steam attemperator or to obtain circulating water pressure. A feedwater valve installed for these purposes also can be used during start-ups or off-normal operations.

Source: Bailey Meter Co., Cleveland, Ohio.

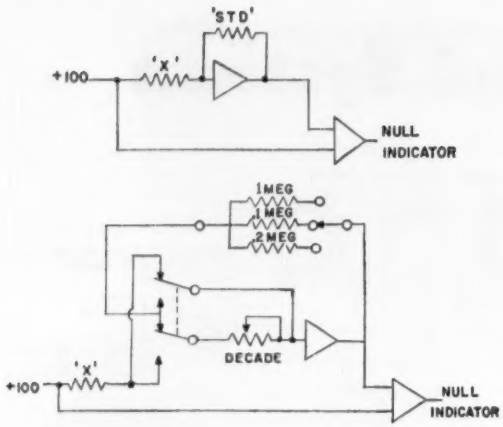
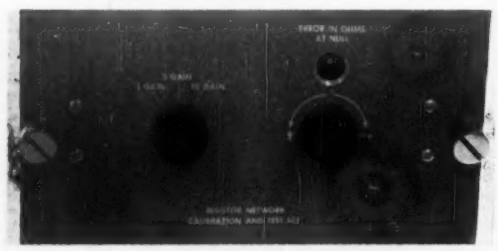


FIG. 1. RESISTOR test. Top shows principle; bottom shows how decade is added in series with either unknown or standard (feedback) resistor.



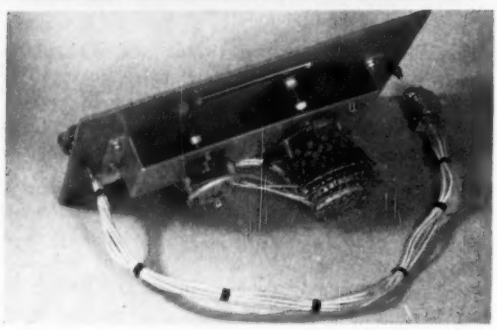


FIG. 2. RESISTOR test panel. Decade has 10-ohm steps from 10 to 100 ohms; 20-ohm steps from 20 to 200 ohms; 100-ohm steps from 100 to 1000 ohms; the 1-, 5-, and 10-gain switch selects decade and corresponding feedback resistor.

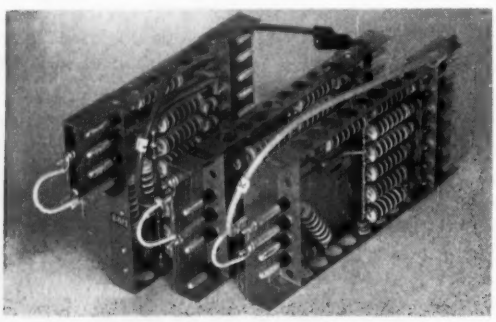


FIG. 3. NETWORK test jumper plug.

Calibration of

R. P. SYKES

Ramo-Wooldridge Div.
Thompson Ramo Wooldridge Inc.*

MANY large general-purpose electronic analog computing facilities have been in operation over two years. Of these facilities, several do not maintain their precision resistors and capacitors in a precisely controlled environment, or oven. Therefore, it is safe to say that a fair percentage of these precision components are sufficiently out of tolerance to degrade the problem solution accuracy by a full order of magnitude from what it was when the equipment was installed. Furthermore, if any precision components have been removed and relocated elsewhere in the computer, the component ratio error will have increased in many cases by a full order of magnitude because of the selective matching of precision components employed initially in several computers.

All analog-computer maintenance facilities should establish a specialized calibration facility and develop test techniques for evaluating their precision components accurately and periodically. Such a facility requires only (1) operational amplifiers, (2) an oven for precision components, (3) a resistor decade box and (4) a modified Wheatstone bridge for resistor measurements. (An "Eput" meter for use in measuring the integrating capacitors will be described later.)

Summing and feedback resistors employed in analog-computer networks are of a high order of precision and cannot be measured accurately by standard bridge techniques because the required match is of the same order of magnitude as the resolution of the best available bridges (0.001%). Since measurement of the absolute value of resistance is of secondary importance compared to measurement of the value of mismatch, an order of magnitude improvement can be realized by measuring the *error* directly, rather than by subtracting two readings of absolute value. An operational amplifier can be used to amplify the error between the resistor under test and a standard resistor.

The resistor test circuit shown in Fig. 1 uses the unknown resistor as a summing resistor, and the standard resistor as the feedback for an operational amplifier. The special decade resistor test panel switching is arranged to permit inserting the decade in series with either the summing (unknown) or feedback (standard) resistor so that the gain of the amplifier can be adjusted to unity whether the unknown is lower or higher than the standard. The decade is

Author was with Space Technology Labs, Inc., when the work covered in this article was performed.

High Resistance Padded Resistors

Analog computers use large numbers of highly accurate padded resistors which determine the gain of the operational amplifiers. The new techniques described here measure the resistance ratios accurately and establish the required corrective padding resistor values, resulting in resistor ratios, and consequent amplifier gains, accurate within 0.001 to 0.005%.

therefore being switched so as to add resistance to the lower of two resistors; if the unknown is low, the decade will indicate "—" at null; if the unknown is high, the decade will be in series with the standard, at null, and will indicate "+".

Since the decade is required to be of the same magnitude as the error in the unknown, its inaccuracy will only affect the estimate of the error, or mis-match, between the unknown and standard; 0.1% decade accuracy will permit measurement of a precision resistor to within 0.0001% (relative to the standard) when the unknown is of the order of magnitude of 0.1% in error:

Resistor error = 0.1% x 1 Meg = 1K
Decade error = 0.1% x 1 K = 1 ohm
Measurement error = 1 ohm/1 Meg = 0.0001%

The special amplifier is used to invert the reference 100 volts, and its output is summed with the original 100 volts in a standard summer using gains of 10.

The output of the second amplifier is metered with a panel-mounted VTVM or DVTVM; the meter accuracy is not critical because the meter is required only to detect a null.

Fig. 2 shows front and back of the test panel, which is engineered to minimize the possibility of operator errors. Setting the left-hand switch to the size resistor being tested (1-, 5- or 10-gain in this case, corresponding to 1 Meg, 200 K and 100 K) automatically masks all but the significant numbers visible in the window above the right hand switch, and makes the appropriate number of zeros appear so that the error indicates directly in ohms on one scale.

The effect of unbalance in the 10-gain summing resistors is eliminated by reversing the input leads and reading "zero" or null as the difference between the two readings obtained. Circuit gains are such that 0.01% error corresponds to the first major division on the meter dial (0.1 volt) so that even the effects of meter zero shift are minute and can be ignored after an initial zero adjustment is made.

The circuit points requiring connection to the amplifiers and unknown resistor are brought from the test panel into the oven through shielded wire.

Each resistor is tested and the errors are recorded on a resistor test card in ohms plus or minus. Then reference is made to a tabulation showing the maximum permissable error in ohms for each size resistor. This tolerance is determined by the computer group relative to the standard they wish to maintain and the amount of work anticipated. We adopted a tolerance of ±0.01% as a temporary measure until all networks were tested. This brought the entire computer up to an "acceptable" standard as quickly as possible. Then the tolerance was lowered to ±0.005% and the networks retested.

Those resistors whose error is equal to or less than the chosen tolerance are checked "OK" on the test card. If any resistors require service the "repair" box is checked on the card and the network is removed for repair.

Certain resistors are not normally available at the patch board and some others are not normally "common" with the summing resistors. Installing a special jumber plug on the rear of the network will complete these connections for test purposes. Fig. 3 shows how these plugs are used on three different networks. A similar adaptation can be made on virtually any network encountered.

Padding

Prior to repair we determine whether the error can be reduced to zero by replacing the padding resistor and what value padder would be required, or whether the entire resistor must be replaced. The padder must be measured to an accuracy within 1% (requiring a Wheatstone bridge) and its value subtracted algebraically from the resistance error. If the difference is negative, it is equal to the value required for the new padder. If it is positive, the entire resistor must be replaced. A simple computer circuit was built which gives this information and minimizes the possibility of human error. It includes (1) a means for entering the error in ohms, plus sign, and (2) a means of reading out the value of the new padder.

Such a computer circuit (Fig. 4) is a modified Wheatstone bridge which permits switching an adjustable pot either in series with the unknown or in series with the adjustabe arm of the bridge. Both adjustable resistances are 1000-ohm, 10-turn, 0.05% pots fitted with digital indicators (the 1000-digit dial reads directly in ohms on the 1000 ohm pot). If the pot labeled "error in ohms" is set to zero the circuit is a conventional Wheatstone bridge. When nulled by adjusting the arm labeled "new padder in ohms," the readout will indicate the actual value of the existing

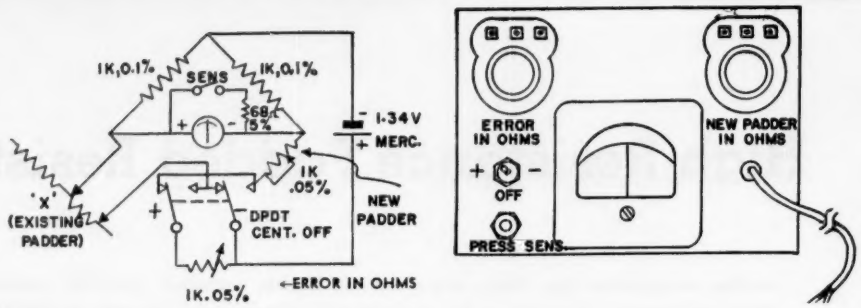


FIG. 4. PADDING-RESISTOR computer.

padder. When the "error in ohms" pot is set to the finite error and the "±" switch positioned so the error value is added to or subtracted from the existing padder, balancing the bridge then causes it to read out the required value of the new padder in ohms. The networks are then repaired as indicated; a heat sink is required in soldering the replacement resistors.

A hi-lo meter sensitivity switch across a resistor in series with the meter prevents the meter from exceeding full scale during preliminary adjustment. The values of the fixed bridge arms and meter sensitivity shown give ample resolution for an accurate null. Each scale mark corresponds to 20 ohms when measuring 1K, and to 2 ohms when measuring 10 ohms.

Following the repair, the leakage from the summer junction to the frame (ground) is measured by a megohmmeter. Conduction from summing junction to ground is a well-known detriment to accurate integrator* operation, and the networks are only one of many places it can develop; 2×10^6 megohms is the minimum acceptable resistance for this test.

The network is then ready for the second preheat and final test (which is identical to the first test).

Amplifier Test Board

As a part of our preventive maintenance program[1] an amplifier test board is used daily to detect network resistors which have drifted out of tolerance. The test circuit involves patching half the summing resistors around to the output, and paralleling the remaining inputs to an input voltage of approximately 90 volts. In this manner, a gain of unity is realized, utilizing all inputs. Any deviation of the output from the input in excess of 5 millivolts indicates a resistor deviation in excess of 0.01% of standard.

Several spare networks will be required to implement this resistor test program without interfering with operation of the analog-computing facility. These spares may be expensive so it is worthwhile to determine the minimum number required.

In order to determine the number of spares needed, take the total number of networks in use and divide by the working days permitted to complete a test of all networks; the result will be the number of networks per day that must be removed because each network is out of use for two days. Multiply this by two to get the total spare networks required. The independent variable is the time allotted to complete a test of all networks. In our installation, three months maximum were allowed arbitrarily to test all networks. We have 84 Type-A, 72 Type-B and 96 Type-C networks, totaling 252. There are approximately 60 working days in 3 months, so networks-per-day equals 4.2. However, we have three types of networks in approximately equal numbers so it seemed expedient to remove either one or two of each type per day. We decided to remove two of each type per day, or six total, requiring $252/6 = 42$ days for completion.

Spare Resistors

A stock of spare 0.01% network resistors and spare 1% padding resistors must be procured. If all goes well the great majority of out-of-tolerance resistors can be brought within tolerance by replacing their padding resistors. Therefore a large number of padding resistors will be required in a wide assortment of values, and only a nominal quantity of each size of complete 0.01% resistor-padder assemblies need be purchased.

The wirewound padders usually used in the original equipment cost approximately a dollar each in lots of 50, and deposited-carbon resistors of the same physical dimensions, tolerance and wattage cost about 50 cents in the same quantities; the decision was made to stock deposited-carbon padders. This decision was further substantiated by the argument that even a 5% change in value of a padder, whose resistance only comprises 0.1% of the total, will only change the total resistance by 0.005%. The observed resistance change of the padders due to soldering heat is less than 0.5% typically and 1.0% max.

These ground rules were laid down to determine what values of padders to buy:

A. If the total resistance error is less than 0.005%, no repair will be attempted.

B. If the total resistance error is greater than 0.1%, the entire precision resistor-padder assembly will be replaced.

These criteria established the minimum and maximum values required. Resistors are therefore ordered in 0.005% steps between these limits. This results in the following list, assuming network values of 1 Meg, 200 K and 100 K: 5-ohm steps from 50 ohms to 100 ohms, 10-ohm steps from 100 ohms to 200 ohms, and 50-ohm steps from 200 ohms to 1000 ohms, resulting in 46 values required.

*To be continued: Mr. Sykes will discuss Integration Error and Associated Measurement Techniques in a future article.

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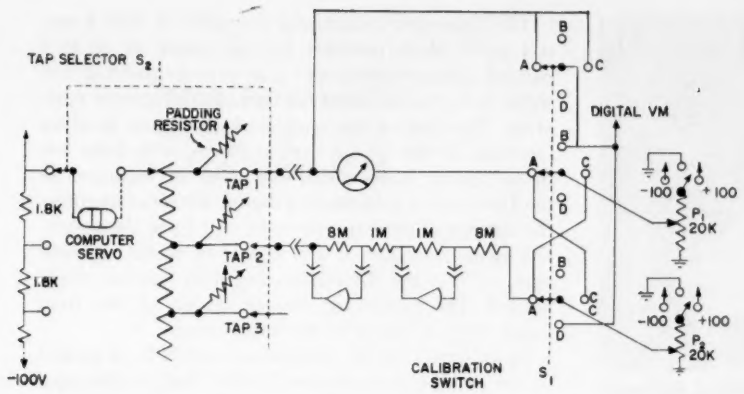

Fig. 1. Operational amplifier holds tap 2 at fixed potential while tap 1 is adjusted.

Calibration Of Padded-Potentiometer Function Generators

This calibration technique uses operational amplifiers to hold one tap of the padded potentiometer at a constant potential while the adjacent tap is being adjusted. Unique feature is that only two precision potentiometers are used.

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University of Arizona

COMPUTER SERVOMECHANISMS driving tapped potentiometers are in common use as flexible and accurate analog function generators.[1,2] A computing potentiometer (usually wirewound) is tapped, usually from 7 to 25 times. An adjustable "padding resistor" connects each tap to an input voltage ($\pm X$), to ground, or to an open circuit. One can thus adjust the tap voltages so that the potentiometer output voltage will be $Xf(\phi)$, where $f(\phi)$ is a reasonable desired function of the angular wiper displacement ϕ; the potentiometer will approximate linear interpolation between successive tap voltages.

To set up a given function, one must adjust the padding resistors with the potentiometer load connected to the wiper. Unfortunately the various padding adjustments interact radically, so that the adjustments must be gone over as many as 10 times. The pot-padder calibrator used in PACE computers (Electronic Associates, Inc., Long Branch, N. J.) avoids such interaction. The 17 tap voltages of a PACE potentiometer are set up initially on 17 precision potentiometers. A switching arrangement permits each successive tap, say the n^{th} tap, to be set to the correct voltage by galvanometer-null comparison with the n^{th} precision potentiometer, while the $n + 1^{st}$ tap is forcibly held to its desired voltage by a pair of operational amplifiers connected to the $n + 1^{st}$ precision potentiometer. Since the $n - 1^{st}$ tap is already set, interaction between padding adjustments is eliminated.[2]

In view of the substantial cost of 15 or 20 precision potentiometers and dials, a new calibrator unit (Fig. 1) was constructed for use in the University of Arizona's analog computer laboratory. *Only two calibrating potentiometers are needed to set any number of taps to their desired voltages.*

These potentiometers are switched alternately to *set* a tap voltage and to *hold* the subsequent tap at the desired level through a pair of operational amplifiers. The latter are connected in cascade so as to have a high input-impedance (8 megohms) and a low output impedance (less that 0.1 ohm).[2] This low output impedance causes the operational amplifiers to be, in effect, a "battery" of adjustable potential; the output voltage will not vary despite large change in load. As in the PACE design, the operational amplifiers are committed by a special patchbay connection only when the calibrator is needed.

Operation of Calibrator

Let us denote the respective voltages desired at taps 1, 2, etc., by $V_1, V_2, \ldots$. The precision potentiometers P_1 and P_2 are initially set to V_1 and V_2 by means of their digit-indicating dials, or with the aid of a digital voltmeter. The rotary 4-position switch S_1 is in position A, so that potentiometer P_2 holds tap 2 at V_2. Switch S_2 positions the potentiometer wiper, with the load connected, on tap 1. The padding for tap 1 is now adjusted until a galvanometer null indicates that V_1 is established at tap 1.

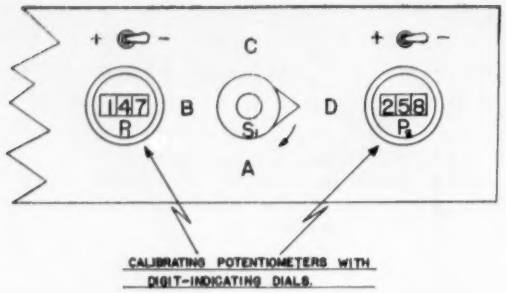

Fig. 2. Front panel controls of calibrator.

Switch S_1 is next advanced to position B; only clockwise rotation is possible. This disconnects P_1 and P_2 from the function pot. The switch pointer-knob on the front panel will point towards potentiometer P_1 (Fig. 2), which is now set to the voltage V_3. P_2 is left alone.

Next, switch S_2 is advanced one position, so that load and balance meter are on tap 2, and the operational amplifier is on tap 3.

Next, switch S_1 is rotated to position C; now P_1 holds tap 3 at V_3, while P_2 (still set to V_2) is used to control the padding for tap 2.

The next quarter-turn advances S_1 to position D, with the switch knobs pointing towards P_2. P_2 is now set to V_4; in this manner, the process goes on until all tap voltages are set. In each case, while one tap is being set the next tap is held at the correct voltage level so that padding adjustments do not interact.

The University's calibrator is combined with a control panel which provides for calibration of up to 6 padded potentiometers and also permits padding networks to be disconnected for linear-potentiometer operation. The cost of the simplified calibrator is below one-fifth of that of the earlier design, with little loss in calibrating convenience and none in accuracy. In the University's calibrator, a digital voltmeter monitors the settings of potentiometers P_1 and P_2 in the respective switch positions B and D as well as the tap voltages, so that the digit-indicating dials are not really needed. The human-engineering design of the front panel (Fig. 2) tends to minimize errors.

In existing (PACE) computers, switch S_2 is located on the padding-network panel rather than on the separate calibrator panel. The new calibrator is so small that it might well be combined with the padding network module, so that S_1 and S_2 could be ganged, if desired.

Acknowledgement

The writer wishes to thank Messrs. H. Koerner and D. Brumbaugh for their help with the construction of the calibrator. The writer is also grateful to the Electrical Engineering Department of the University of Arizona and to Dr. P. E. Russell, Department Head, for their continuing support of this project.

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2. Korn, G. A. and T. M. Korn, *Electronic Analog Computers*, 2nd ed., McGraw-Hill, New York, 1956.

ADDITION TO PREVIOUS
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Logger Typewriter

Alphanumeric Typewriter

Full and direct alphanumeric input, output and control for the Bendix G-15 general-purpose digital computer is now provided by the alphanumeric typewriter shown. Every character on the keyboard—upper-case and lower-case alphabetic characters, numbers, symbols, and carriage controls—can be typed into and out of the computer. Speed is 10 characters/sec.

The typewriter is directly alphanumeric because the user types exactly what he sees on the keyboard, as in normal typing. Even the shift key is used in the normal typing manner, and no shift symbols need be programmed. Also, the computer's built-in paper tape equipment can be operated manually from the typewriter. Controls are provided to fully rewind the tape in the photoelectric reader magazine, to reverse the magazine one block, and to punch tape. The typewriter can be operated in alphanumeric mode, or in numeric mode (as with present G-15 typewriters); the desired mode is selected manually, or by a single stored command.

RUDOLPH F. HAUTLY
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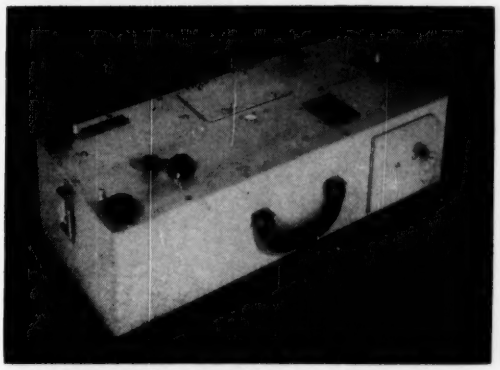
CARL KISSLINGER
St. Louis University



PORTABLE SEISMOGRAPH for blast or vibration measurements.

Seismograph Structures

Measurement of ground motion is a unique problem because the entire environment is in motion. Here are the various constructions designed to establish a stable reference point with respect to which ground motion can be measured.

MOTION must always be measured with respect to some frame of reference; thus the fundamental problem of seismometry is to establish some point which remains relatively fixed in space, with respect to which the ground motion can be referred.

The complete instrument for recording ground motion is called a *seismograph*. It consists of the seismometer (detector) with damping, a transducer, a recorder, and some means of marking the passage of time. For some applications various amounts of amplification and filtering are introduced between the transducer and the recorder. In earthquake work it is essential that the record be tied to absolute time with great accuracy. In prospecting or blast measurements, it is only necessary that the passage of time be marked accurately.

Recording the complete motion of the ground requires detection of three components—one vertical and two horizontal components at right angles to each other. In exploration for petroleum and the determination of the depth to rock for engineering purposes, frequencies of the order of 20 to 200 cps are of interest. In recording explosions, such as quarry blasts, frequencies from 1 cps to 200 cps second are observed. In the detection of earthquakes, frequencies are so low that it is more convenient to talk of periods, which range from about 0.5 to perhaps 6 or 8 seconds per cycle for earthquakes near the observatory. In the case of a distant earthquake, periods from 6 seconds up to almost an hour have been determined. As a complete seismograph recording channel acts as a band-pass filter, a complete earthquake recording station should have at least two sets of instruments, each with detection of three components. One is a short-period set (1- to 2-second period) and one a long period set (10-second period or longer).

Basic Seismometer Structures

With the exception of the strain seismograph, the seismometer is always based on a linear mass-spring constrained to oscillate with one (occasionally two) degrees of freedom.

A simple mass-spring system (Fig. 1A) will measure vertical motion. This is done in the Benioff seismograph and in many prospecting seismometers, and requires that the free period of the detector be relatively short in order to keep the dimensions of the instrument reasonable (a ten-second period requires a spring 80′ long). However, if sufficient gain is available through the transducer, the frequency range can be extended by connecting the seismometer to a sensitive long-period galvanometer.

In order to use a mass-spring system as a *displacement detector*, the natural frequency of the system should be lower than the disturbance frequency, as has been discussed previously.* In other words, it is

*Article "Fundamentals of Restrained Motion," April, *Instruments & Control Systems.*

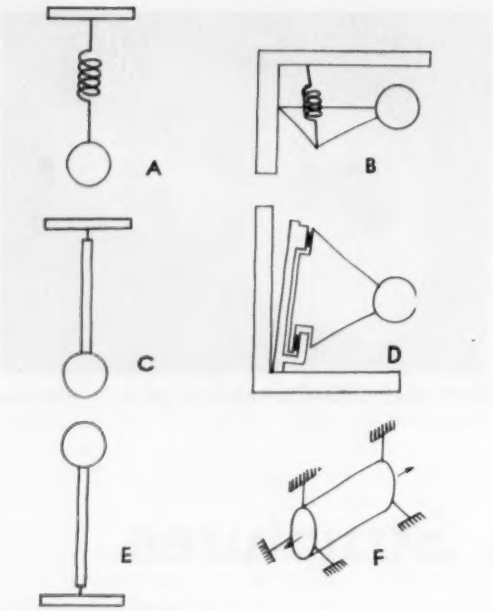


FIG. 1. STRUCTURES for isolating a mass from earth motion. A and B are for vertical motion; C, D, E and F for horizontal motion.

desirable that the seismometer have a long period. Obtaining this long period (low natural frequency) requires ingenious devices for measuring vertical motion. Many use a hinged boom carrying a mass at one end and supported in a horizontal position by a spring (Fig. 1B). As the period is increased, instability caused by variations in temperature and atmospheric pressure are encountered. Using the principle of the zero-length spring, introduced by LaCoste* in 1934, instrument designers have succeeded in producing vertical seismographs with periods of the order of a minute. A long-period vertical seismometer of recent design is shown in Fig. 2.

Horizontal Motion

In principle, the ordinary physical pendulum (Fig. 1C) could be used to detect horizontal ground motion. However, the need for a long period with reasonable dimensions again has led to adoption of a variety of oscillating systems.

Perhaps the most used system is the *horizontal pendulum* (Fig. 1D) in which a boom is mounted so that it is free to rotate about an almost vertical axis. With such a system, periods of 20 seconds are obtained easily. A modern long-period horizontal seismometer based on this principle is shown in Fig. 3.

Another device long used in seismic instrumentation is the *inverted pendulum* (Fig. 1E). Here gravity is used as an astatizing (negative restoring, or unstabilizing) force, and a lengthened period is obtained. This system now finds its chief application in instruments for recording in the vicinity of earthquakes and blasts (Fig. 4).

*L. V. LaCoste, "A New Type Long Period Vertical Seismograph," *Physics*, Vol 5, page 178, 1934.

Fig. 1F shows a *short-period detector*, which has a mass constrained to move in one horizontal direction by elastic members at each end.

In the *torsion pendulum* (not shown) a light mass is mounted eccentrically on a taut torsion fiber; this is a variation of the horizontal pendulum, and is used in the Wood-Anderson seismograph.

Transducers and Galvanometers

The mechanical energy represented by the motion of the inertial member relative to the frame of the seismometer must be converted into a form suitable for recording. In the mechanical-optical type of seismograph, such as the Wood-Anderson and the Sprengnether blast seismometer, this motion is used to rotate a mirror. A beam of light reflected from this mirror is recorded photographically. In this system magnification is provided entirely through mechanical and optical levers.

To provide greater magnification, and to make possible filtering and electronic amplification, most modern seismographs convert this mechanical energy into an electric signal. Many schemes have been employed; the most popular now in use are the *moving-coil* (Galitzin type) transducer, and the *variable-reluctance* transducer. In either, the output is proportional to the *velocity* of the inertial member relative to the frame.

Transducer output usually is recorded by a D'Arsonval galvanometer. A beam of light reflected from a mirror on the galvanometer coil is focused on a photographic record. The galvanometer must have high sensitivity for earthquake work. The free period and degree of damping are selected to give the desired frequency response for the channel.

In general, the *magnification* of a seismograph is the ratio of the trace amplitude to the amplitude of the parameter being measured (displacement, velocity or acceleration), and is a function of the frequency of the ground motion. The frequency response of the seismograph is determined by the free period and damping of both the seismometer and the galvanometer. Many adjustments of these quantities have been employed to meet such special needs such as achieving a response peaked at some frequency of interest, or obtaining a flat response over some particular band. An advantage of galvanometric recording for earthquake observation is that the response of seismographs is low for the high frequencies produced by traffic, wind, and human activities, and for the long-period tilts produced by earth tides.

Recorders

In photographic recording, still the most popular recording method, photographic paper is moved past the light spot by a suitable drive system. In earthquake applications, in which the system must operate continuously, the paper is placed on a drum which is driven along a helical screw. Thus, it is possible to get 24 hours of record on a piece of paper of reasonable size. Chart speeds of 15, 30 and 60 millimeters per minute have been used. Higher chart speeds are required, of course, to resolve the high-frequency ar-

rivals found in the neighborhood of an explosive source. For blast recording and seismic prospecting, speeds of 6 to 24 inches per second are employed. In these cases the record is a tape or strip.

The interval at which time marks are placed on a record also depends on the application. For earthquake observations, marks tied by radio signal to absolute time are recorded at intervals of one minute. For high-speed recording, timing marks are at intervals of 0.02, 0.01, or 0.005 second.

The inconvenience of developing a photographic record to check for an earthquake has led to increased use of visual writing recorders as auxiliary equipment. If a photoelectric cell and amplifier arrangement are used to drive the visual recorder, a single mirror on the galvanometer is sufficient for both recorders.

Applications

Seismographs were originally created to record the motion of the ground resulting from earthquakes. Since waves from a major earthquake penetrate to all parts of the earth, a global network of seismograph stations has developed. The data provided are the chief source of information from which geophysicists have derived the present concept of the internal constitution of the earth.

Special instruments are employed, principally by the United States Coast and Geodetic Survey, for the recording of strong motions of the earth. Usually the recorder of such an instrument is triggered by the first impulse of the earthquake, and recording continues for a sufficiently long time to assure a complete picture of the events that occur.

Waves in the earth also can be used to investigate the local geological structure that must be known in locating deposits of petroleum. The art of prospecting for oil with the seismograph has developed to a high state; closely related to this use is application to the determination of the depth to bedrock, to the ground water table, or to other significant subsurface horizons.

The seismograph can be used also to determine the severity of vibrations created by blasting. This has provided those who use explosives a tool with which to monitor their operations. Similar instrumentation is useful for determining the severity of vibrations produced by heavy machinery, pile driving, etc. A portable seismograph for blast and vibration measurements is shown in the headpiece.

Nuclear Test Monitoring

A pressing international question at present is whether tests of nuclear weapons can be reliably detected by the seismograph. There is no question as to whether the ground waves generated by such an explosion can be detected by the seismograph; the difficulty is in the ability to distinguish between waves from nuclear weapons and waves from earthquakes. There is not now agreement that, if a nuclear test site were located in a highly seismic area, it would be possible to pick out a weapons test from the frequent earthquakes. In addition, as the yield of the device that it is required to detect is reduced, the density of the network of seismic stations must be increased.

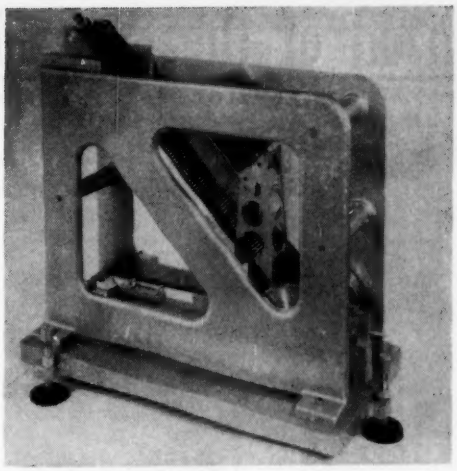


FIG. 2. LONG-PERIOD, vertical-motion detector.

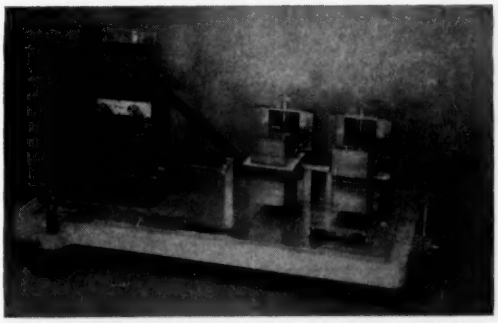


FIG. 3. LONG-PERIOD, horizontal-motion detector using structure of Fig. 1D.

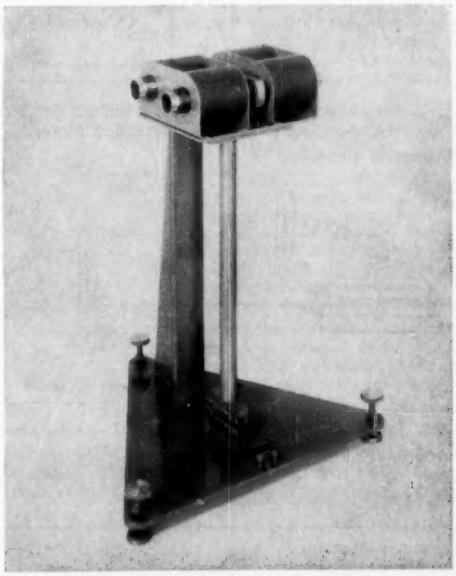


FIG. 4. INVERTED pendulum with mass at top; spring at bottom restores pendulum to vertical.

Journal of the S C M A . . .

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Gas Pressure Regulators

Temperature, time and velocity can be used to alter distribution pressure to compensate for pipeline losses and keep delivered pressure reasonably constant.

ROBERT C. LISK
Fisher Governor Co.

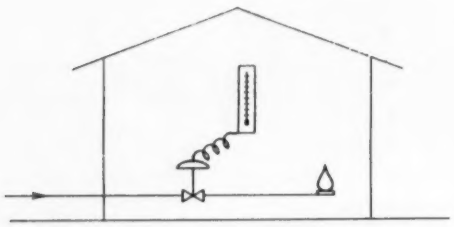

Fig. 1. Temperature-actuated space heater.

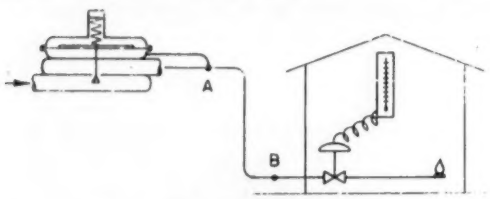

Fig. 2. Pressure regulator delivers constant pressure to point A. However, pressure at point B depends on drop in pipeline.

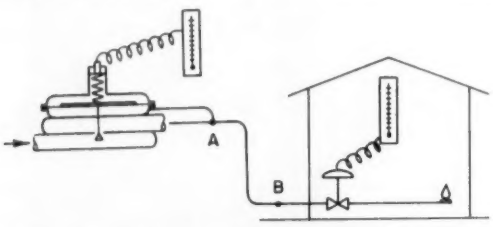

Fig. 3. Pressure at A can be increased when outside temperature falls, thus offsetting pipeline drop between A and B to keep pressure at B reasonably constant.

November Meeting: Thursday, the 19th, Rio Hondo Country Club, Downey, Calif.
Feature: Henry L. Bechard, Product Manager of Thompson-Ramo-Wooldridge will discuss "When to Consider Using Computer Control.

GAS FUELED SYSTEMS, such as space heating systems (Fig. 1), will operate best when supplied with gas at a reasonably constant pressure; variations in inlet pressures must be minimized.

This can be accomplished by a gas pressure regulator (Fig. 2) designed to receive inlet pressure which may vary from 5 psi to 1 psi, and deliver a nearly constant pressure on the downstream side. As the gas required downstream of the regulator may vary from thousands of cubic feet per hour to nothing at all, the regulator must have high rangeability.

The pressure regulator operates to maintain the pressure constant at point A in Fig. 2. However, the more inadequate the piping from point A to point B, the more the delivered pressure (point B) depends on rate of flow.

As rate of gas flow (and resultant service-line pressure drop) is a function of outside temperature, a thermometer can be used to increase the pressure setting of the regulator with falling temperatures and decrease it with rising temperatures (Fig. 3). This compensates for pressure drop in pipelines where there is reasonable correlation between gas load and temperature.

Compensation also can be provided when the gas load has a time pattern, merely by substituting a clock for the thermostat.

A regulator using *both* a clock and a thermostatic element is used widely as a district regulator in gas utility distribution systems (Fig. 4). The regulator is responsive to outside temperature and increases gas pressure output proportionally as atmospheric temperature drops below +60°F. A time clock over-rides and negates the pressure boost provided by the temperature auxiliary during that period when gas requirement is not a function of outside temperature (from late in the evening to early in the morning).

Presented at SCMA-LAHJC Short Course, March 26-27, 1959, Wilmington, Calif.

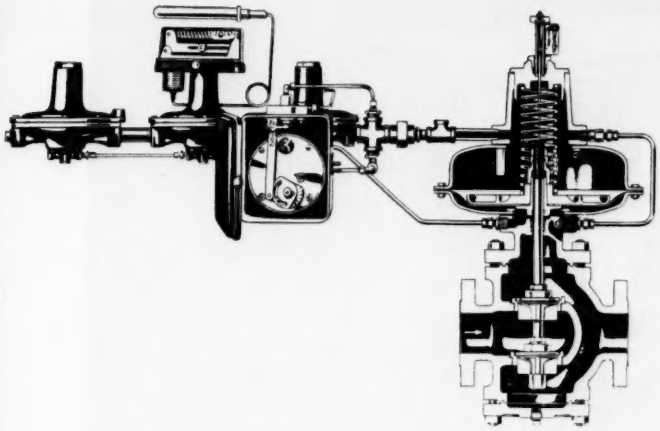

Fig. 4. Time-temperature gas pressure regulator.

Velocity Correction

A more direct compensation for pressure drop between A and B in Fig. 3 is based on the *velocity* of gas flowing from the point of pressure reduction to the building or load. Fig. 5 shows a regulator for doing this. An orifice (19) in the pipeline downstream of the regulator creates a pressure drop proportional to the flow. The differential pressure is imposed on opposite sides of a large diaphragm in the regulator. This diaphragm is linked (4) to the pilot (14) on the regulator proper. As the orifice differential increases with increasing flow, the resulting force across the diaphragm increases the outlet pressure setting of the pilot. This provides velocity-correlated compensation for pipeline pressure loss from the regulator to the point of use.

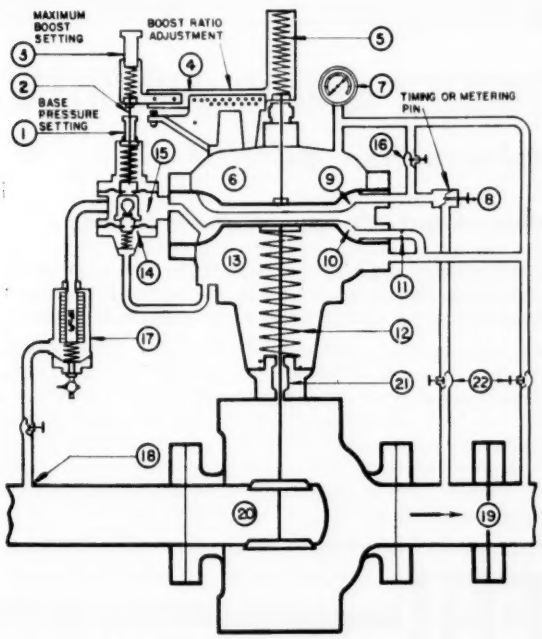

Fig. 5. Velocity compensation.

Calibrated, Dual Switch TEMPERATURE CONTROL **B27A**

TYPE **B27A**

United Electric's Type B27A Temperature Control is a local mounted, enclosed unit that has been designed for applications where it is desirable to control two separate circuits at different temperatures by means of a single control unit. Independent switch adjustments provide a maximum span of approximately 20° F between switch settings, and this span is constantly maintained throughout the control range.

Adjustable Range	Ranges of 50° or 100° F. between limits of 50° and 400° F.
Maximum Difference Between Switch Settings	Approximately 20° F.
Switch Ratings	Up to 15 amps. at 115 or 230 volts A.C. 20 amp. A.C. or D.C. switches also available.
Switch Types	N.O., N.C., or double throw — no neutral position.
Adjustments	By rotating a single turn knob and pointer against a calibrated dial. Individual screw adjustments on switches for adjusting span between switch settings.
Electrical Connections	Via ⅞" diameter clearance hole and an internally mounted terminal board.
Mounting	In any position by the ½" NPT on the immersion element.
Enclosure	Cast aluminum case with black wrinkle finish. Bright-dipped brass immersion element.

UNITED ELECTRIC manufactures a complete line of temperature, pressure, and vacuum controls. For special applications, standard units may be modified, or custom-built units may be provided.

For additional information on local mounted temperature controls, including Type B27A, request Section 100 of our new catalog.

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You can design virtually to perfection and have a permanent, visual record of performance before building pilot models or prototypes. As a result, "cut and try" expense is reduced.

The same quality workmanship and design that has made Electronic Associates the world's leading producer of precision general purpose analog computers will be found in this new unit. Accuracy to ±.1 per cent. Modular construction allows you to select varying quantities of the following computing functions: summation, integration, multiplication or division, function generation, parameter adjustment, logical comparison.

***For complete engineering data, write for Bulletin* TR-10-E**

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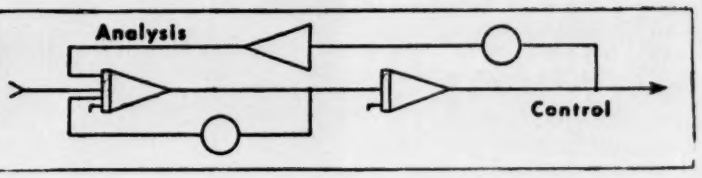
The SIMULATION COUNCIL Newsletter



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Bits

This month most of the story of the January meeting of the Midwestern Simulation Council as per P. J. Hermann, and a bit of amplification of a Castro-Updike paper from the April meeting of the Eastern Simulation Council.

The Midwestern Simulation Council report covers talks by: *Robert Mudd* on "A Precise Speed-Regulating System Using Operational Amplifiers"; *James Graham* on "Sampling and Quantizing Limitations in Digital Simulation"; *Vincent Rideout* on "Errors and Servo Performance Criteria"; mention of a talk by *Mihajlo Mesarovic* on "Control of Multi-Loop Interacting Systems", and one by *Klaus Frielinghaus* on automatic control for railway classification yards, which will be fully reported next month.

Invitation for Papers

We lead off this month with the following invitation for papers as part of the concentrated effort which the Simulation Councils are making to have this a really interesting and worthwhile meeting for analog and simulation people. Certainly the WJCC is cooperative; they have offered us four sessions (if we can get the papers) and have even used the word "analog" in the invitation. Note also their effort to facilitate "real-time comprehension". Good!

"Computers—Challenge of the Next Decade" is the theme of the 1960 Western Joint Computer Conference scheduled for next May 3, 4, 5 in San Francisco, California.

Special emphasis will be placed on spotlighting the major areas where new planning, and new research and development programs are to be directed to guarantee the foundations for the computer growth destined for the Decade 1960-70. For example, papers on break-throughs in concepts and techniques in the newer areas such as language translation, data retrieval, and self-teaching systems would be of particular significance. It is of course intended that the conference shall also serve effectively as a base for technical papers and discussions pertaining to the current state of the computer art —both analog and digital.

The Conference Proceedings incorporating the papers to be presented at the 1960 WJCC will be distributed at the registration desks. They will be of value to the conference attendee in facilitating not only his post-conference study, but also his real-time comprehension of the technical sessions. Papers to be submitted to the Technical Program Committee should be prepared on the basis of a thirty-minute delivery, extra time being available for discussion. Evaluation will be based on study of an original draft of the complete paper, three copies of which should be in the hands of the committee as early as possible—by November, 1959 at the latest. No advance abstract of the paper will be required, but notification of intent to submit a paper should be provided as soon as possible to facilitate program planning. A convenient postcard form is enclosed for this purpose. The papers will be reviewed, final selection made, and authors notified by 25 January, 1960. The papers must then be received in final form by the Technical Program Committee by 1 March for incorporation into the Conference Proceedings.

The cooperation of all individuals and organizations participating either directly or indirectly in making the 1960 WJCC Technical Program a success will be appreciated.

Pieces

MIDWESTERN S/C MEETING OF 12 JAN ON "ANALOG COMPONENTS IN CONTROL"

About 66 people attended a meeting of the Midwestern Simulation Council held at the Allis-Chalmers Manufacturing Company in Milwaukee, Wisconsin on 12 January 1959. A tour of the Allis-Chalmers facility in the morning was followed in the afternoon by five speakers discussing "Applications of Analog Components in Control Systems" under the chairmanship of *Ralph King* (Caterpillar Tractor Company, Peoria, Ill.).

Ralph first introduced *John Bullock*, Assistant to the Allis-Chalmers Director of Industrial and Community Relations, who welcomed the group and briefly reviewed his company's business operations.

Mudd on Speed-Regulating System

The first speaker was *Robert Mudd* of the A-C Engineering Analysis Section, which is headed by *Dr. Eldo Koenig*, host for the occasion. Mr. Mudd described in some detail "A Precise Speed-Regulating System Using Operational Amplifiers." As this system was also described in a September 1958 AIEE publication "Applications and Industry" under the heading "The Design of a Drive System for a Rotating Arm", your Editor will give only a general description of the problem and solution here.

Allis-Chalmers has an analog-computing facility, Mr. Mudd said, for simulating systems which incorporate the power equipment and control devices which they produce. This requires the simulation of voltage, current, and speed regulators, of turbo-alternators, steel mill machinery and, of late, nuclear reactors.

The specific example Mr. Mudd used was the velocity control of a rotating arm test facility being built at the David Taylor Model Basin for testing models of torpedoes, submarines, and surface ships.

The circular pool shown in the sketch (Fig. 1) is 260 feet in diameter and 20 feet deep. Models are tested by attaching them to a carriage under the arm. Surface ships are usually tested in this basin under condition of no waves, so the arm must accelerate to speeds up to 0.45 radians per second (which corresponds to a speed of 30 knots at 120 feet from the center) and stabilize to within 0.1% within half a revolution, and then hold that accuracy for the other half-revolution while tests are made.

For underwater tests, where waves are unimportant, the system must be capable of 0.71 radians per second (50 knots) in 2½ revolutions. As the arm weighs about 37,000 pounds, and is flexible, and the motor mounted on it weighs 40,000 pounds, this amounts to quite a power control problem.

Fig. 2 shows a simplified diagram of the drive system. Of particular interest to simulation people is the fact that not only was an analog computer used to simulate the overall system, but, as shown, analog components* were incorporated in the actual control system.

Speaking of the simulation, Mr. Mudd explained that it was partially direct in that operational amplifiers in the computer simulated operational amplifiers in the control system, a thyratron was tied into the simulation in the place of the control system thyratron, and a static Regulex was used to introduce the proper time constant.

The simulation also required 18 integrators, about half a dozen inverter-summers, and assorted plug-in resistors and capacitors.

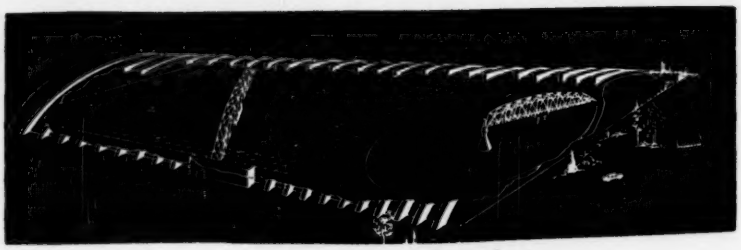


Fig. 1. Rotating-arm hull-test basin.

Graham on Sampling and Quantizing

The next speaker was *Dr. James Graham* (Marquette University, Milwaukee) who spoke on "Sampling and Quantizing Limitations" in Digital Simulations. "I will assume," said Dr. Graham, "That you have not used digital simulation very much and therefore make my remarks fairly general and introduce only some basic concepts and limitations."

Analog simulations have the "niceness" of being able to operate in real time, ease of programming, and of giving a sort of physical feel for what you are doing. And in many cases you can do analog simulations at lower cost.

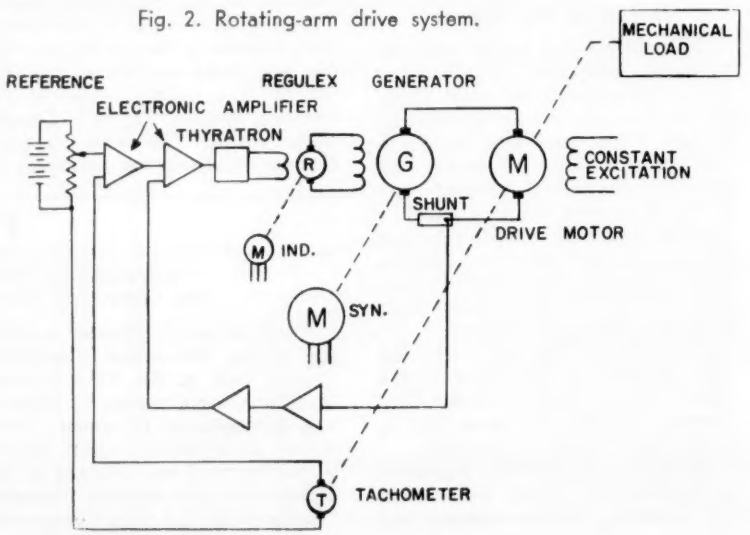
Digital simulations offer the possibility of greater accuracy, and of programming some things that are relatively difficult on an analog computer, like nonlinearities. Sometimes a digital computer is faster, but usually it isn't.

Digital computers have pretty well taken the scientific world by storm in the last ten or fifteen years. Most of us who have encountered Koenig feel that digital computers are capable of doing almost anything. There was the same sort of situation earlier when people used to think you could do anything with electronics. But as we are well aware, there are limitations in electronics and there are limitations in digital computing and digital simulation!

Real-time digital simulation differs from analog simulation in two very important areas: One is the *sampling rate* and the other is the *quantizing level*. *Fig.* 3 shows what is probably the most general type of digital representation of a continuous quanity. Usually digital samples are taken at equal intervals of time or at equal levels of amplitude. The length of the time increments is the sampling period and the levels which the digital device recognizes are quantizing levels.

The sampling period that should be used in simulating a physical system depends upon several things. The two most important are (1) The type of signals, and (2) The system into which they are to be fed. From in-

Fig. 2. Rotating-arm drive system.



*Beckman operational amplifiers

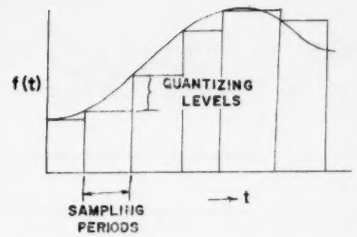


Fig. 3. Digital representation.

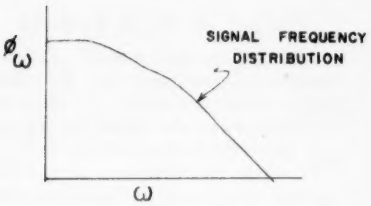


Fig. 4. Data distribution.

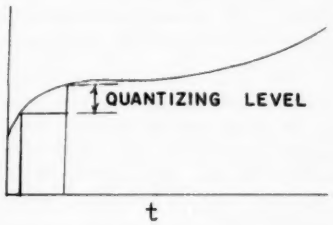


Fig. 5. Quantizing error.

formation and communication theory we get the theorem that the minimum sampling rate should be at least two times per cycle of the highest frequency present in the signal. Thus for a signal having a frequency distribution like that in Fig. 4 the theorem says that if we sample at twice that frequency in which the distribution reaches zero, we should be able, theoretically, to recover all of the information contained in the signal. However, in practice the figure turns out to be five, ten, or even forty times the frequency. This, for our present digital computers, is a serious limitation.

The effect of quantizing levels can be seen by reference to Fig. 5. This is a compromise situation. If the quantizing unit is too large we lose accuracy. On the other hand, if it is small we must make the sampling rate correspondingly fast to realize the potential gain in accuracy.

So at present there are two major limitations to the digital simulation of physical systems in real time which I wish to emphasize in some detail. There are others, such as the sampling durations and ambiguities of sampling instants and things like that, but as they are less important

analog simulation speeds design, development of RADAR and COMMUNICATIONS SYSTEMS
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• Analog evaluation by methods similar to actual test methods, timing, frequency adjustments, bandwidths and band-pass scaling, analysis by oscilloscope presentations.

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*The Defense Systems Department of General Electric, Syracuse, N. Y. selected the GPS Computer for their communication and radar optimization studies. By using analog techniques they propose to save considerable time and money by combining and compressing the stages of the development cycle.

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than the sampling rate and quantizing level by an order of magnitude, we will not consider them here.

John Salzer (Magnavox Research Labs, Los Angeles 64, Calif.) wrote an article* on the frequency analysis of digital computers, which showed that something as simple as an integration on a digital computer requires various numerical techniques. This introduces a new type of limitation—i.e., the numerical techniques, programs, or operations in the digital computer required to simulate the physical system. The more complex the numerical techniques the longer the program will take.

R. E. Graham and *Kelly* at Bell Labs are interested in simulating a certain type of coding for TV signals. Using an IBM 704 to simulate TV pictures for coding, they found they had to decrease the resolution of the TV screen to 1/25 normal. This meant that instead of the usual 500-plus lines they had only 100 lines. Nor did they have as many points across the line as the present standard TV picture. This turned out not to be bothersome at all for their purposes; they were able to study their coding process in spite of the slight decrease in quality. (The picture looked a bit grainy.) Some of the numerical values used: something like 2.4 seconds per frame, 500 samples per second, 100 lines per frame, and each sample had a quantum level of 1024 levels per sample. This gives an idea of the upper limit of intelligible information a digital computer can now produce in real time.

Several refineries are using digital simulators and digital computers to simulate their processes, or parts of them. The aircraft industry apparently still favors the use of analog simulation. The desire to simulate more accurately than is possible on present analog computers seems to be bringing on higher-speed digital computers. However, where analog simulations are accurate enough there is, of course, no reason to go to the more expensive general-purpose digital computers for simulation. As a compromise the less expensive digital differential analyzer (DDA) has been mentioned as a possibility for digital simulation in real time.

* * *

William Peet (Electronics Associates, Inc., Long Branch, N. J.) asked "Are there any particular rules by which you can pick out the sampling rate and quantizing levels?" Dr. Graham didn't think this question could be answered without extensive knowledge of the digital computer to be used and the system to be simulated. Perhaps the best approach would be to solve for the frequency response based on the frequency-response anlaysis to help select the one system of equations to give you the minimum operations for your particular computer. "I haven't worked out any specific rule of thumb to answer your question," he said.

The next question came from *Paul Alper* (University of Wisconsin, Madison): "Couldn't you eliminate the pilot run? I thought its usual function was to pick out a certain quantizing level and to make a run and try another level and compare the two." Dr. Graham answered, "Do you know the accuracy you want in the information you wish to get?". For instance, in the aforementioned TV work perhaps 0.1% was accurate enough. In that case there would be no real need to try to quantize better than that. "It is a matter of judgment as to what level you should work at." Alper then asked if it would be advisable to make two runs to see whether quantizing in a finer level would give significant improvement in the results. This could certainly be done whether or not it depends on the particular applications. The actual analysis of the quantizing level conditions is extremely difficult to carry out on a pencil-and-paper basis. There are several approaches: one is to treat the quantizing level as a noise type of signal, and another is to use a statistical approach and relate the output in terms of the statistical distribution.

Tom Arai (Borg-Warner Research Center, Des Plaines, Ill.) asked about differentiation as a digital process. Dr. Graham explained that there is a similar method carried out by Salzer for a differentiation scheme and referred to in Salzer's paper in the 1953 IRE Proceedings.

A. L. Gardner (General Electric Company, Cincinnati 15, Ohio) asked whether the sampling period must be constant over the full frequency band, as indicated by the transfer function. Dr. Graham replied that it depends upon the particular system. In the usual application referred to in technical articles and textbooks, the sampling period is held constant. "Then the sampling rate is the criterion of the maximum frequency response. I am referring now to a computer such as the IBM 704. What is the maximum rate? I refer to frequency rate rather than time rate." Dr. Graham didn't have that information, but Dr. Koenig spoke up to say he thought it was about 100 cycles per second for the 704.

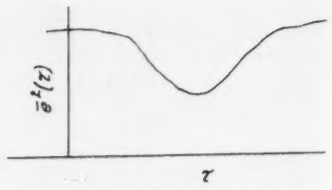


Fig. 6. Generalized error squared.

Rideout on Servo Criteria

The next speaker was *Dr. Vincent Rideout* (Department of Electrical Engineering, University of Wisconsin, Madison), who spoke on "Errors and Servo Performance Criteria."

In a general dynamic system, if the input is designated as r and the output as c, the definition of the error is given as

$$\text{error} = e(t) = r(t) - c(t)$$

One of the measures for error in a system is the average error squared

$$\bar{e}^2 = \frac{1}{T}\int_0^T [r(t) - c(t)]^2 dt$$

In most control systems there is some unavoidable lag, which may be allowable but which must be taken into account in the error criterion. In this case

$$\text{error} = r(t) - c(t + \tau)$$

Here we have the delayed error, which is the difference between the input and the output advanced, or between the input delayed and the output. Now if we apply the squared error equation we get

$$\bar{e}^2 = \Phi_{rr}(0) + \Phi_{cc}(0) - 2\Phi_{re}(\tau)$$

which may be considered the autocorrelation of the input plus the autocorrelation of the output, both at

$$\tau = 0$$

and minus twice the cross-correlation between input and output, as a function of τ.

The mean squared error criterion is the most popular because it can be handled easily mathematically. On an analog computer, however, some other criterion might be more desirable: the absolute value of the error, for example. Working with analog computers Dr. Rideout and his colleagues began thinking about other criteria, and the idea almost got away from them.

If you plot the delayed or generalized error squared function you get a curve like the one in Fig. 6. For a linear system these curves usually have a minimum at some positive value of τ and peak out at various places elsewhere. The position and depth of this minimum provide a good way of comparing linear and nonlinear systems.

*IRE Proceedings, 1953.

SPEAKING WITH EASE®

An up-to-the-minute report on computer technology prepared by the **Beckman/Berkeley** *engineering staff*

New Advances in Recent Computer for Boeing

A 50 ft. EASE computer shipped to Boeing September 1, is worth looking at as a concrete example of what can be done with the new techniques and equipment we have been reporting in these columns. This all-electronic, digitally-controlled installation is a far cry from the first .01% computers that appeared three years ago. There's too little room to detail all the improvements that distinguish this polished product from the creatures of an earlier age, but let's run through a few more recent advances.

Coordinate Transformations at Electronic Speeds

The servo-resolver, one of the last vestiges of wheel-and-lever analog computing, has finally disappeared. Electronic sine-cosine generators now join with electronic multipliers to translate polar to rectangular coordinates and vice versa. This means that any problem involving resolution can now be handled at computing speed of integrators and summers, that is, at roughly 100 times the speed formerly possible. And accuracy, far from declining as was the case when the first non-linear electronic components appeared, is greater than that achieved with servo resolvers.

This computer can perform fourteen coordinate transformations simultaneously. Sines and cosines are generated with an accuracy of .05%, electronic products with an accuracy of .02%.

Amplifiers that drift only 20μv per week

Drift has been one of the most bothersome faults of amplifiers and one of the toughest engineering problems to lick. Amplifiers in this computer are conservatively specified to drift less than 20μv per day. Tests show a normal drift of less than 20μv per week. Drifting at this rate, the amplifiers require balancing only once a week to maintain .01% integrating accuracy.

The low rate of drift opens up another intriguing possibility: that of balancing grid current against the stable offset, cancelling both sources of error, and thus achieving unprecedented integrating accuracy. We have tried this technique with favorable results. A full report will appear in next month's issue of "Speaking with EASE."

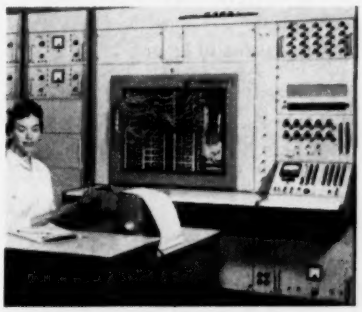
Better Centralized Control

Now you can do more and see more without leaving the console. To wit:

(1) The pushbutton selector enables the operator to inspect voltages at any of up to 1500 points in the computer. Voltages may be read to .01% on the digital voltmeter, to .001% using the analog-type null meter.

(2) Power supply currents can be measured at the console.

(3) A bank of close-set indicating lamps identify overloaded amplifiers by number.



One of two interlocked control consoles, showing Flexowriter used for programming, checkout and recovery of data either manually or by punched tape.

(4) The patchboard is laid out to order; thus assuring the best arrangement of terminals for the type of problem anticipated.

Complete Automatic Checkout

The DO/IT system will scan all desired points in the computer, compare voltages with the proper values, and print out the location of any discrepancies together with the actual value. This enables an operator to pinpoint errors due to patching, mechanization or faulty components without a moment's delay.

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Following are just a few of the possible criteria for errors:

Integrated error:

$$E = \int_0^\infty [r(t) - c(t)]\, dt$$

Squared error:

$$E = \int_0^\infty [r(t) - d(t)]^2\, dt$$

Delayed error:

$$E = \int_0^\infty [r(t - \tau) - c(t)]\, dt$$

Absolute value of error:

$$E = \int_0^\infty | [r(t) - c(t)] |\, dt$$

Integral of absolute value of delay error (IADE):

$$E(\tau) = \int_0^\infty | r(t - \tau) - c(t) |\, dt$$

Integral of time multiplied by absolue error (ITAE):

$$E = \int_0^\infty t\, | r(t) - c(t) |\, dt$$

It is easy to see that we can generalize the error function by making the integrand an arbitrary function of the error, the delay, and time:

$$E = \int_0^\infty F[t(r(t - \tau) - c(t))]\, dt$$

By selecting the appropriate function certain portions of the error signal can be emphasized or de-emphasized, for example the effects of overshoot, or an initial error in a transient response.

Dr. Rideout showed a number of slides illustrating different applications of the various error criteria. He had used an analog computer to develop the illustrations, most of which were for the transient response of second- and fourth-order systems to step inputs.

There are two aspects to the application of this type of criteria:

One is that the customer can explain what he wants by specifying some criterion to be satisfied. And since virtually all control systems have some nonlinearities, the criterion might be one of the nonlinear types that properly fits the job at hand.

The other aspect is that the engineer applying the control system can set up his own criterion to help get good results.

Dr. Rideout concluded his talk with a brief description of the error criteria used in a study of a speed governor loop for a diesel engine at Allis-Chalmers.

* * *

P. J. Hermann (Goodyear Aircraft, Akron 15, Ohio) asked, "Are you going to use this criterion for feedback, or just as a measure?" Dr. Rideout answered that the result was to be used as a feedback in the sense that, having selected the criterion you can adjust the parameters to minimize the result of the error, but the human has to close the loop.*

Dave Sparks (Tammen & Denison, Chicago 5, Ill.) asked whether Dr. Rideout had considered applying some of these methods of linear programming to make automatic adjustments to reach the optimum. Dr. Rideout replied that he felt this was the next step.

He went on to comment on an IRE paper by *Professor Ernst Guillemin* (MIT, Cambridge 39, Mass.) on "What Is Nature's Error Criterion," saying that he felt that nature has no error criterion. We can use the mean square of error because it's nice, it's related to power, and it's easy to handle. But there is good reason to choose others.

It was pointed out that if you are trying to hit a target, a miss is as good as a mile, so there's no reason to penalize for big overshoots.

Vernon Larrowe (Willow Run Research Center, Ypsilanti, Mich.) said he had been bewildered at first because "You were integrating to infinity and getting finite answers. Is that because you were using step disturbances and the error dwindled out?" Dr. Rideout answered yes, that in the case of a step input and a type-one system or higher the error dwindles down to nothing unless you have static friction—which you always do. Thus it becomes even more desirable to use some of these geometrically-defined error functions to take into account such things as residual error.

John Anderson (Allison Div., GM Corp., Indianapolis, Ind.) observed that sometimes the integration was from zero to infinity, but for the squared error it was from minus infinity to plus infinity. Dr. Rideout explained that with transients we always begin the integration at zero, because we consider the transient to have been initiated at zero except when it started at τ. Analytically, the integral for a random input is taken from plus to minus infinity. In practice, though, it's always nice to start things off in a computer at zero rather than try to go back to minus infinity.** We are limited, too, in how long we can carry out this integration.*

Vern Larrowe commented that you can reverse time in analog computers so that you can first integrate from zero to plus infinity, then reverse time and integrate from zero to minus infinity and add the two to get the total integral.**

Professor Rideout distributed some copies of University of Wisconsin Engineering Experiment Station reprints:

"A General Criterion for Servo Performance" by W. C. Schultz and V. C. Rideout; U. of Wis. Eng. Exp. Sta. Reprint #331.

"The Selection and Use of Servo Performance Criteria" by W. C. Schultz and V. C. Rideout; U. of Wis. Eng. Exp. Sta. Reprint #326.

"Correlation Studies of Linear and Nonlinear Systems" by M. G. Spooner and V. C. Rideout; U. of Wis. Eng. Exp. Sta. Reprint #300.

These are available from the University on request.

Mesarovic on Interacting Systems

The fourth speaker, *Dr. Mihajlo Z. Mesarovic*, is a native of Jugoslavia in the United States on a Sloan Fellowship. He spoke on "Control of Multi-loop Interacting Systems" in behalf of MIT and George A. Philbrick Researches, Inc. His talk concerned the development of feedback control loops in multi-loop systems through complex linear active filter systems which will help simplify the problem of control of these multi-loop systems. Unfortunately, Dr. Mesarovic did not supply the Midwestern Simulation Council's secretary with a copy of his notes, and the taped recording of his remarks was unintelligible over the background noise of the auditorium.

Last speaker of the day was *Klaus Frielinghaus* (General Railway Signal Company) who gave a most interesting discussion on use of analog-computer techniques for car sorting in the New York Central's Robert R. Young Yard in Elkhart, Indiana. To do justice to this talk your Editor is holding it over till next month's *Newsletter*.

Updike and Castro on Extraction Calculations

Otis Updike (University of Virginia, now at Cal Tech and UCLA) has sent us "an official copy of the abstract" of the paper, mentioned briefly in a previous *Newsletter* by

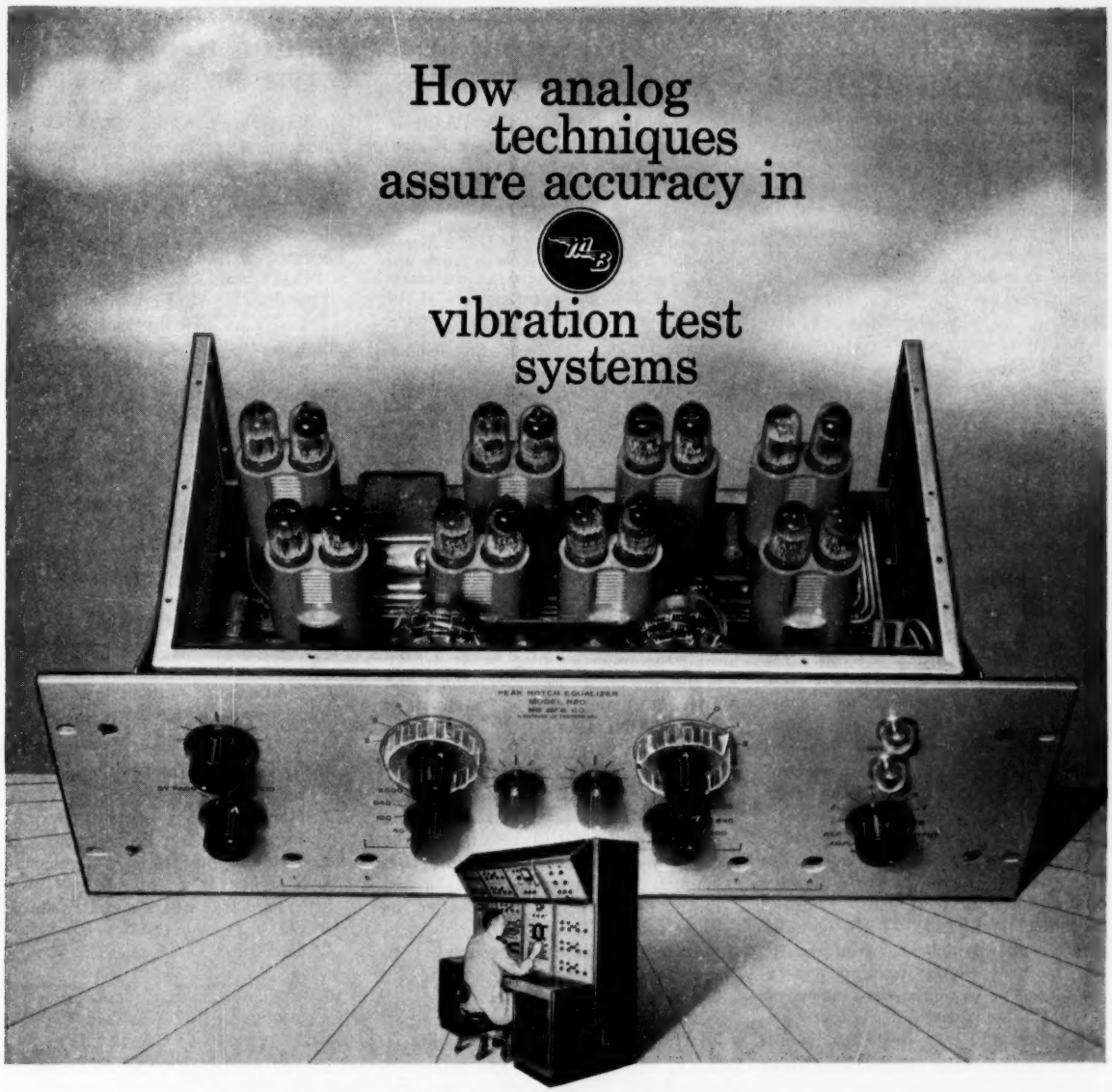
*Why??—Ed.

**Lazy!

*Impatient, too.

**Hear!

How analog techniques assure accuracy in MB vibration test systems



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Otis and Patricio Castro.* This is on "Application of Analog Computing Equipment to Extraction Calculations."

"It resulted," Otis adds, "from a misuse of analog-computing equipment which we perpetrated with some success at the University. Castro applied enough ingenuity and industry to the PACE in computing steady-state stagewise extraction cascades that he was able to show an advantage over more usual methods for large or frequently-calculated systems. Since the equations are large sets of simultaneous, non-linear algebraic expressions, they waste the dynamic capabilities of the analog equipment. At the same time they (1) strain weak operations like division and function generation and (2) require duplicated memory of computing components, either (a) two alternately used storages (which Pat got by using separately-programmed integrators) or (b) manually—or servo-set transfer of output to input as information is "ping-ponged back and forth between duplicate sets of gear—i.e., pots are used as memory elements. Both approaches will work."

Herewith the abstract:

In a study of the speed and accuracy advantages of analog computation for the diffusional operations, several mechanizations of a stagewise, countercurrent extraction cascade were devised. For a ternary system, the simplest setup required six coefficient "pots," eight computing amplifiers (three as active filters), three diode function generators, and a five-cup servomultiplier. This mechanization, though restricted to steady-state problems, yields data on flow rates and compositions between stages as well as on number of stages. It was tested on a Type I liquid-liquid system in which acetone was extracted from water by trichloroethane. After setup, the number of stages could be calculated twice as fast as by graphical methods, with only slightly lower accuracy. Since setup time is longer, the analog method is superior only when many stages (in one or several cascades) are to be computed for the same system. Principal sources of error were the function generators and a division circuit. Changes in both should result in improved performance. Extension of the technique to other flowsheet configurations, to distillation, absorption, or adsorption, and to transient conditions may be made.

*Who, Otis explains, is a member of the "Chilean, or clean-shaven branch of the family"

Information (Without Theory)

From the "Annales de l'Association Internationale pour le Calcul Analogique":

In order to help members wishing to familiarize themselves with the applications of analogy in certain countries, the Association is willing to put them in touch with firms who would agree to take probationers.

We wish to thank our readers in advance for their help in writing to us and in diffusing this information.

With this object, the Association requests Societies and Institutions who would agree to take people wishing to study the applications of analogy in foreign countries, for short periods, to make themselves known at the Editorial offices of the Proceeding of the International Association of Analogue Computation.*

The Association hopes to act as a sort of catalysing agent, promoting the diffusion of knowledge and applications in analogy.

P. J. Hermann (Goodyear Aircraft Corporation, Akron 15, Ohio), Secretary of the Midwestern Simulation Council, says that judging from his mail the most popular Study Group is the one on *Human Physiology and Dynamics* and that a number of M. D's. have asked to be put on the mailing list.

An interesting development!

A while back *Mr. B. W. Littlejohn* of Ocean Falls, B. C., Canada wrote us asking about the meaning of the diagram which heads the Simulation Council Newsletter. Just in case you might be interested, we replied as follows:

"Rather than being intended to represent any one thing specifically, the diagram was selected as a generalization; a sort of abstract symbolizing analog computer diagrams.

"Although the foregoing is the reason that the diagram was selected, it is not meant to imply that it does not have a specific meaning—it does. The triangles with the double line are the accepted symbol for an analog integrator and the other triangle for an analog summer; the circles are the symbol for potentiometers. The tail of the arrow indicates the input to the system, and the arrow head the output. The small lines coming from nowhere and going into the integrators indicate the initial condition, i.e. the value of the variable out of the integrator at time $t = 0$. As shown, the circuit is an oscillator which would produce a sinusoid at the output having a frequency dependent upon the major loop gain and therefore controllable by the potentiometer at the upper right and a damping rate which is the function of the setting of the potentiometer at the lower left. A handy circuit, but selected not for that reason but simply because we liked its looks.

"Don't you?"

To this Mr. Littlejohn replied:

"Yes, I do like the look of it. So much so that I had already painted it on my safety hard hat as an emblem of my trade, namely instrument mechanic. I am glad to say that only one electrician has been foolhardy enough to ask me what it represents, God rest his soul."

Maybe we should sell decals!

*Association Internationale pour le Calcul Analogique, Presses Académiques Européennes, 98, chaussée de Charleroi, Brussels, Belgium.

Information—Request for:

At a recent meeting of the Western Simulation Council the following topics were considered for discussion at future meetings:

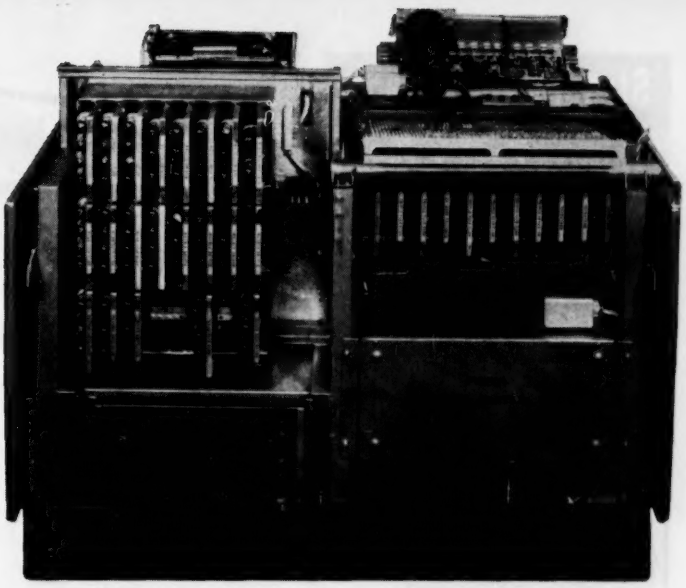
1. Recording, Storage, and Playback Techniques
2. Non-linear, Intermittent, and Automatic Scaling Procedures
3. Tricks of the Trade in Simulation
4. Stability of Components
5. When Is Linearization Permissible?
6. Statistical Techniques in Simulation
7. Use of Analog Techniques in Evaluation of Flight-test Data; i.e. Post-flight Simulation
8. What Does the Future Hold for Analog Computers?
9. Use of Perturbation and Other Techniques for Extending Analog Accuracy
10. Problems We'd Like to See Solved or Devices We'd Like to See Developed

These topics are listed here because if any reader should be in a position to give an informal talk on any of them I am sure that their local Simulation Council would like to hear from them. On the other hand, if anyone can offer a formal paper on these or allied subjects, your Ed. would positively like to hear from you because of the all-out effort the Simulation Councils Inc. are making to get a number of really worthwhile analog—or simulation by whatever means—papers on the program of the Western Joint Computer Conferences next May.

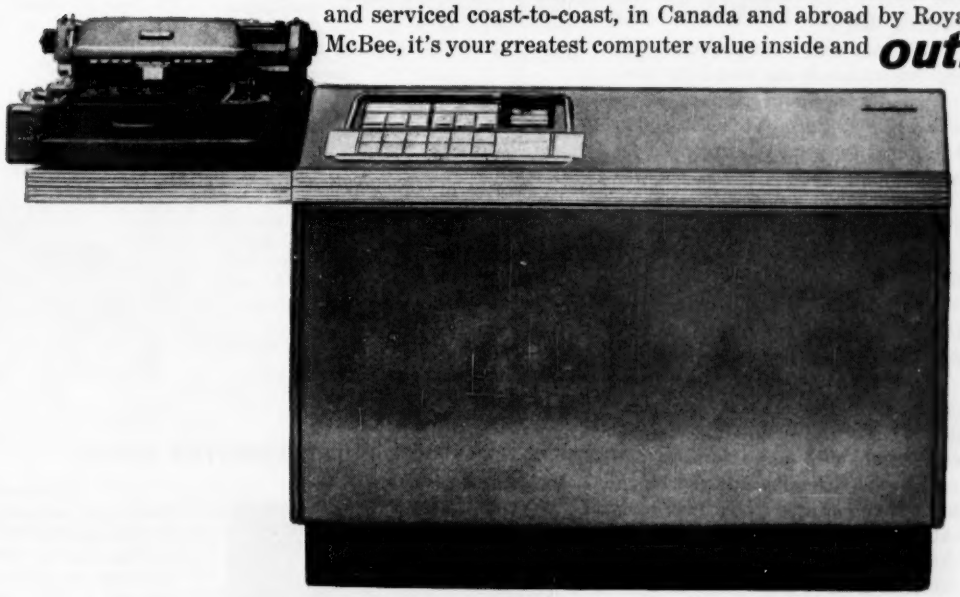
ROYAL PRECISION

LGP-30

Your greatest computer value on the market...



inside . . . The world's largest-selling engineering and scientific computer, the compact, mobile LGP-30 is also the lowest-priced complete computing system you can buy or lease. It gives you the largest memory (4096 words) and capacity in its class. Internal components have been greatly reduced to insure highest operating reliability. The logic circuit and few etched circuit cards are easily removed for checkout and maintenance. ***and*** . . . The LGP-30 operates from any wall outlet, requires no site preparation. With its simplified command structure, the LGP-30 is the easiest computer to program and operate. It is delivered complete with tape typewriter for alpha-numeric input-output. An extensive library of programs and sub-routines is available. Sold and serviced coast-to-coast, in Canada and abroad by Royal McBee, it's your greatest computer value inside and ***out.***



Royal Precision Corporation

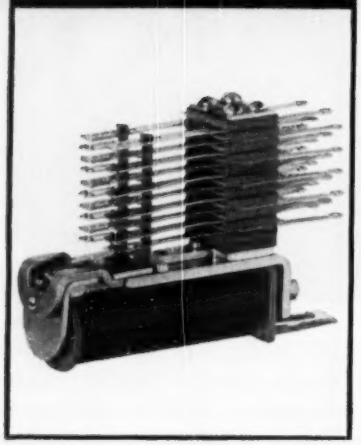
Royal Precision is jointly owned by the Royal McBee and General Precision Equipment Corporations. LGP-30 sales and service are available coast-to-coast, in Canada and abroad through Royal McBee Data Processing offices. For complete information write **ROYAL McBEE CORPORATION,** data processing division, Port Chester, New York

CIRCLE 67 ON READER-SERVICE CARD

Stromberg-Carlson

"TELEPHONE QUALITY"

Relays



. . . featuring new high-voltage types for test equipment or other high-voltage applications.

THE insulation in the new relays withstands 1500 volts A.C.—3 times normal. These high-voltage models are available in Types A, B and E. They are the latest additions to the Stromberg-Carlson line of twin contact relays—all available for immediate delivery.

The following regular types are representative of our complete line:

Type A: *general-purpose relay with up to 20 Form "A" spring combinations. This relay is excellent for switching operations.*

Type B: *a gang-type relay with up to 60 Form "A" spring combinations.*

Type BB: *relay accommodates up to 100 Form "A" springs.*

Type C: *two relays on the same frame. A "must" where space is at a premium.*

Type E: *has the same characteristics as the Type A relay, plus universal mounting arrangement. Interchangeable with many other makes.*

Complete details and specifications are contained in our new relay catalog, available on request. Write Stromberg-Carlson Telecommunication Industrial Sales.

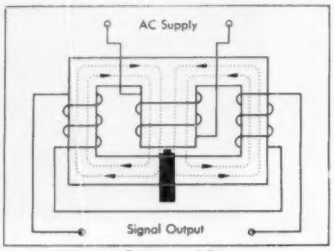
STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**
113 CARLSON RD. • ROCHESTER 3, N.Y.

CIRCLE 68 ON READER-SERVICE CARD

new instruments

FOR FURTHER INFORMATION USE THE FREE ORDER CARD ON PAGE 1597

MOTION TRANSDUCER



Schematic Diagram of flux pattern with armature centered.

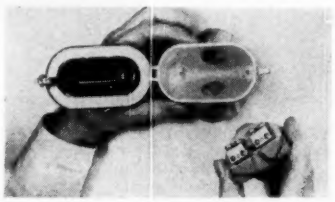
New Metrisite Motion-Sensing Device has performance characteristics "several orders of magnitude greater than any other transducer or control device available today." Resolution is such that measurements as small as one ten-millionth of an inch (one-tenth of a microinch) can be made. Light operating force will activate the moving element. Linearity of 0.1% due to the absence of hysteresis losses. Electrical output is of such a magnitude that the Metrisite can provide full-scale operation of a sensitive rectified-type meter directly without amplifier; outputs as high as 100 v. Employs a "B"-shaped magnetic core with an electrical coil around each of the three cross members. The center cross member has air gap in which a small movable copper slug moves. When an a-c input energizes the center primary coil, a magnetic field is set up in both loops of the core, which in turn induces a voltage in each of the two outer secondary coils. With the copper slug at dead center, the magnetic fields are symmetrical and the induced voltages in the secondary coils are equal. Slightest movement of the slug off center produces an unbalance of the two magnetic fields, which results in an electrical output signal caused by the difference in voltage in the two secondary coils.—*Brush Instruments, 37 & Perkins, Cleveland 14, Ohio.*

CIRCLE 164 ON READER-SERVICE CARD

THERMOCOUPLE HEAD

New Thermocouple Head assembly with a flip-top cap has a ceramic block which takes wires from 8 gauge down to the smallest sizes, and with a simple modification can be used with other types of standard thermocouple heads.—*Pyrometer Co. of America, Inc., Penndel, Penna.*

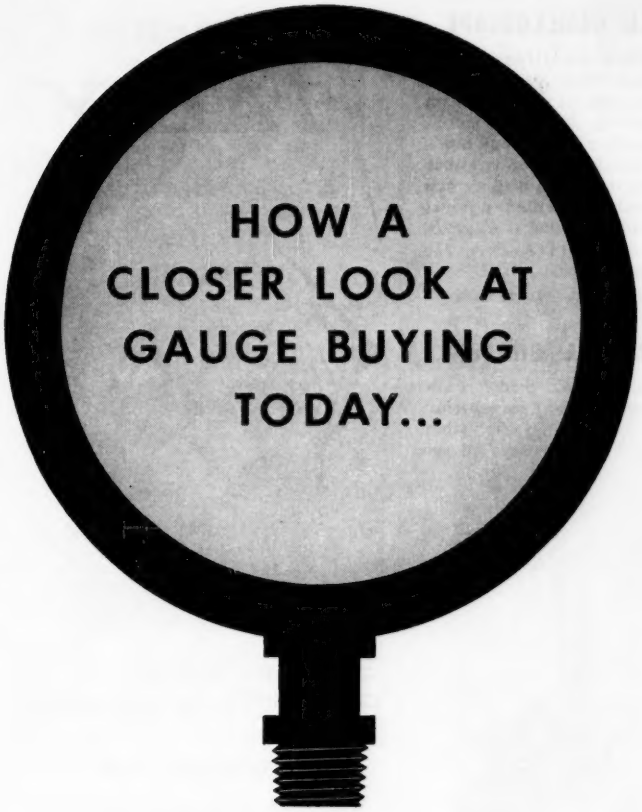
CIRCLE 165 ON READER-SERVICE CARD



THERMISTOR BRIDGE

CIRCLE 166 ON READER-SERVICE CARD

New Thermistor Bridge, Model TB-2, has accuracy of 0.1% of substituted power (50 times more accurate than power meters specified to be accurate to 5% of full scale in substituted power). Designed for use in calibration of output of signal generators at 1.000 milliwatts.—*Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md.*

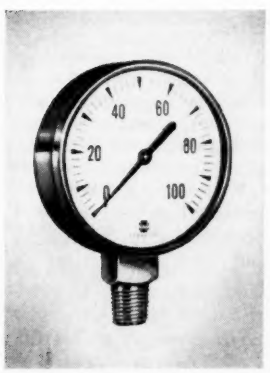


can give you a tighter grip on gauge costs!

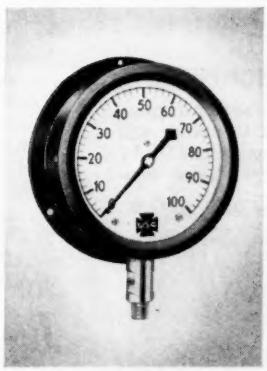
Been looking at gauge buying in your plant as "routine"? In terms of gauge performance you need, accuracy you get, price you pay . . . and how and where you buy? You can pick up real savings with a closer look at your gauge requirements . . . and at what United States Gauge offers. USG features the world's largest stock of indicating dial pressure gauges. Over 50,000 standards, plus specials, with all possible choices of sizes, case stylings, pressure ranges and case materials . . . up to and including the finest gauges of highest accuracy. One source meets 99% of your pressure gauge needs, with the exact gauge for the exact purpose at the right price. And one phone call to your USG distributor taps that source. See the Yellow Pages, or write for catalogs and name of your nearest USG distributor today.

UNITED STATES GAUGE

Division of American Machine and Metals, Inc., Sellersville, Pa.



Replacement costs too high? Volume - priced, precision - built USG drawn-case gauges are the money-savers for replacement of any A.S.A. Grade B gauge in your plant (accuracy of 2% guaranteed). These standbys are specified by more than 60% of original equipment manufacturers today. Proof of USG reliability and value! *Write for Catalog 64A.*



Paying a premium for quality design, reliability? Check the new USG A-Line, premium design at savings up to 40% of premium prices! Meets A.S.A. Grade A Standards, including accuracy of 1%. Wide range of cases, sizes, movements, pressures cuts *you* in on A-Line savings wherever you need dependable gauge performance. *Write for Catalog 305.*

Paying for performance you don't get? Look at the USG Supergauge® line. Built like a watch to A.S.A. specifications for Grade AA Test Gauges, these gauges pay for themselves in long-lived, dependable performance and lower maintenance costs. Accurate to 0.5% of scale range. Full selection of case styles, sizes and options. *Write for Catalog 1819.*

Losing out on highest accuracy? USG Test Gauges are the elite of the industry, equalling or exceeding A.S.A. Grade AA standards with accuracy as high as 0.2 of 1%! Styles, sizes and case materials for all types of laboratory and test uses. You can't buy higher quality and precision in a test gauge! Get your money's worth at USG. *Write for Catalog 400.*

CIRCLE 69 ON READER-SERVICE CARD

VARIAN
Potentiometer
RECORDERS

Used by the thousands because . . .

1. THEY ARE TRULY

PORTABLE

The Varian G-11A weighs only 15 pounds and can be carried anywhere in the laboratory, plant or field. And because it is a potentiometer recorder, it is highly sensitive and can be adapted to extremely varied recording requirements.

Varian recorder prices from $365; full-scale balancing time 1 or 2½ seconds; ranges from 0-9 millivolts to 0-100 volts, wide choice of speeds, accessories and charts. Full specifications and description available by writing the Instrument Division.

VARIAN associates
PALO ALTO 1, CALIFORNIA

CIRCLE 71 ON READER-SERVICE CARD

DUAL-BEAM OSCILLOSCOPE

New Model 411 Oscilloscope is "only true dual-beam oscilloscope." One gun can be used as a single beam oscilloscope having identical amplifiers, each amplifier having one millivolt full-scale sensitivity, while either the X- or Y-input of this display can be simultaneously presented against time on the other channel.—*Allen B. Du Mont Laboratories, Inc.*, 750 *Bloomfield Ave., Clifton, N. J.*

CIRCLE 172 ON READER-SERVICE CARD

FLOW RATE CALIBRATOR

New portable, bench model Flow Rate Calibrator is designed especially for checking rotameters or other flow devices with inert gases in the

range of 1 to 5000 cc/min. Is a dry-seal, volumetric-type gas collecting unit utilizing a patented, frictionless mercury "O"-ring seal between a piston and precision-bore glass tube. Details in Specification Sheet SS-903. —*Brooks Rotameter Co., P. O. Box 432, Lansdale, Penna.*

CIRCLE 173 ON READER-SERVICE CARD

EDUCATIONAL COMPUTER

New Spec, a general-purpose stored-program digital Computer and digital differential analyzer (DDA) is completely modularized and com-

pletely transistorized and utilizes high-speed digital circuitry. All internal logical interconnections between the plug-in modules are effected via a removable plugboard patch pan-

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Bi-directional
Paper Tape Reader

It reads paper tape rapidly and economically

Tally Series 424 Paper Tape Readers furnish a new low cost approach to rapid search and accurate punched paper tape reading. Self contained, this unique bi-directional asynchronous reader is available in both rack and console styles.

It features...

A reading rate of 60 characters per second in either direction—instantly reversible. Triggered tape feed readout. Full accountability with form C switch providing positive hole/space identification. Reads 5, 6, 7, or 8 channels without modification. Low cost, only $595 for console unit. Can be slaved to any other 60 character device.

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REGISTER CORPORATION
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CIRCLE 74 ON READER-SERVICE CARD

el. By replacing the GPC (general-purpose computer) patch panel with the DDA panel, it is coverted into a digital differential analyzer containing 20 integrators. 14-page Catalog S1 gives details.—*Computer Control Co., Inc., 2251 Barry Ave., Los Angeles, Calif.*

CIRCLE 174 ON READER-SERVICE CARD

SOLID-STATE CONTROL SYSTEMS

New solid-state electric control components and systems use a transmission signal of −25 to +25v dc,

compatible with present data handling and performance monitoring equipment. Details in Product Specification E74-1.—*Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.*

CIRCLE 175 ON READER-SERVICE CARD

SQUARE ROOT INTEGRATOR-COMPUTER

New panel-mounted Square Root Integrator-Computer C3A/1 is for use in flow measuring systems requiring a digital readout of totalized flow. Is intended primarily for use in Swartwout AutroniC(R) control systems. Installed in parallel with an AutroniC flow indicator, recorder and/or controller, it operates from a common 0-0.5 vac signal and has no effect on the control loop. The square root is extracted by inter-posing a flyball governor in the feedback loop from the servo motor to the servo amplifier. The flyball governor, rotated by the servo motor, exerts a force proportional to the square of its speed. Digital totalization is continuous and accurate from one to 100% of the input signal. Data are supplied in Specification Sheet No. A-807.—*The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.*

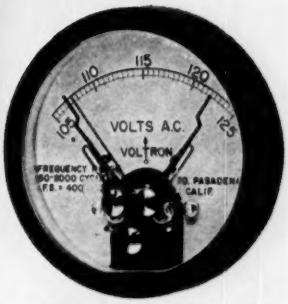
CIRCLE 176 ON READER-SERVICE CARD

IF THE CARD HAS ALREADY BEEN USED, MARK NUMBER AND DATE OF ISSUE ON POSTAL CARD AND SEND C/O OUR READER SERVICE DEPT.

ap + VOLTRON

ADDS 1 UP

TO 4-10 TIMES GREATER ACCURACY



EXPANDED SCALE METER-RELAYS

Voltron and API combine the best features of their two top instruments . . . the resulting expanded scale Meter-Relays can monitor and control any electrical variable that is measurable. These instruments are now the most accurate and reliable Meter-Relays available.

- 10,000,000 make-break cycles, with 100% perfect contact
- Low current and voltage inputs required
- Eliminates problem of load isolation in measuring circuits
- Available in 2½", 3½" and 4½" models

Many more advantages — get complete data from either firm . . .

See them at Wescon — API Booth 3101 — Voltron Booth 3417

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Assembly Products, Inc.
Chesterland, Ohio

VOLTRON
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CIRCLE 77 ON READER-SERVICE CARD

WHEN YOU HAVE
extraneous common mode signals

AND WANT TO MEASURE
0.1 to 100 millivolts full scale

AND THEN AMPLIFY

CHOOSE THE NEW HONEYWELL D-C AMPLIFIER

AccuData II

wide-band differential all-transistor D-C Amplifier for strain gages and thermocouples

- **Full Scale Input:** Unbalanced: ±100 μv to ±100 mv Differential: ±3 mv to ±100 mv Open Loop: Below drift level
- **Full Scale Output:** ±2v at 50 ma, dc to 10 kc
- **Frequency Response:** to 20 kc
- **Output Impedance:** Less than 0.5 ohm at dc on all ranges
- **Input Impedance:** Unbalanced 3 to 100 mv ranges; greater than 20 megohms in parallel with 350 micromicrofarads. Differential: Greater than ± 2 megohms
- **Equivalent D-C Input Drift:** Less than 2 μv/10°F ambient temp change on 0.1 to 30 mv input ranges
- **Equivalent Input Noise:** 4μv peak-to-peak on 100 μv to 300 μv range (0-10 cps). 8μv rms on 10 to 30 mv ranges (0 to 100 kc)
- **Common Mode Rejection:** 200,000 at 60 cps on 3 to 30mv ranges

The new Honeywell AccuData II is a completely transistorized D-C Amplifier designed for use in high accuracy data handling systems as a wide-band pre-amplifier for strain gages and thermocouples. Its output can be fed to electronic or electromechanical analog-to-digital converters and simultaneously recorded on galvanometer oscillographs or magnetic tape. Either differential or single-ended input modes can be selected by an eleven position range switch. This switch changes the gain in three-to-one steps. Intermediate gains with high resolution are provided by a ten-turn potentiometer. Write for AccuData II Bulletin to Minneapolis-Honeywell, Dept. 50, Boston Division, 40 Life Street, Boston 35, Mass.

Honeywell

H HONEYWELL *First in Control*

CIRCLE 78 ON READER-SERVICE CARD

TEST CHAMBER

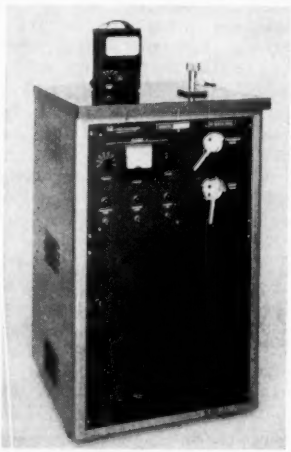
New Tenney-3 is smaller-space temperature Environmental Chamber with characteristics usually reserved for bigger models. Is a three-cubic-foot, front-opening upright chamber to which relative humidity can be

added at the buyer's option. Heretofore the 10-cu-ft Tenney-10 was the smallest model available with humidity option. Features include: Temperatures down to −120°F, and up to +350°F. Options include relative humidity of 20% to 95% in the dry bulb range of 35° to 185°F.—*Tenney Engineering, Inc., Union N. J.*

CIRCLE 177 ON READER-SERVICE CARD

ARGON LEAK DETECTION

New V.I.C. Argon Differential-Sorption Leak Test Station is "first really low cost complete facility for fast detection and pin-pointing of leaks." Has high sensitivity, compar-



able to that of the mass-spectrometer-type detector, and can be used for the same general application with lower investment. Uses inert argon gas, as well as helium, which is in short supply and often restricted entirely. The sensing element detects all inert gases without machine modifications or adjustments.—*Vacuum Instrument Corp., Huntington Sta., N. Y.*

CIRCLE 178 ON READER-SERVICE CARD

NO TEMPERATURE OVERSHOOT

WHEN SIMPLYTROL MINDS THE POT

time-proportioning controller has unique anticipating action

Low-cost Simplytrol gives you high-accuracy temperature control . . . effectively maintains temperature to within ± 1°F. of set point on most applications. An ingenious anticipating circuit eliminates overshoot difficulties by shutting off heat input at a time-proportioned interval before the set-point temperature level is attained.

Built around the well-proven A.P.I. meter-relay design, Simplytrol uses no amplifying circuits or vacuum tubes; it is exceptionally stable and reliable. The unit is available in thirty ranges from −400°F. to +3000°F., is packaged in a newly re-styled table-mounting case that converts in minutes to panel mounting.

SEND FOR DATA SHEET 9-B

api ASSEMBLY PRODUCTS, INC.

S.A., 1913

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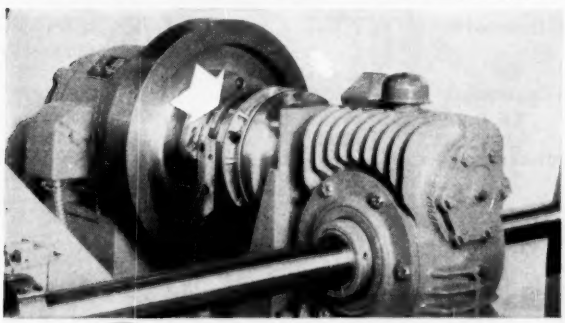

Simplatrol

ELECTRIC CLUTCHES & BRAKES

. . . Assure Super Clean Cutting Action In High Speed Power Shear

This is a Simplatrol C-B 160 Electric Clutch & Brake unit 6½" diameter at work in a high speed power shear.

Here the swift, quiet, durable Simplatrol Clutch and Brake unit mounted between the main motor drive and gear reducer gives clean cutting action; up to 70 strokes in an operating minute. Energized clutch moves the blade and rugged brake stops it, following single stroke cutting action.

Simplatrol Clutches and Brakes do their job silently . . . eliminate the constant noise usually associated with clutching and braking. Simplicity is keynoted in the patented diaphragm . . . the only moving part in the Simplatrol Clutch and Brake.

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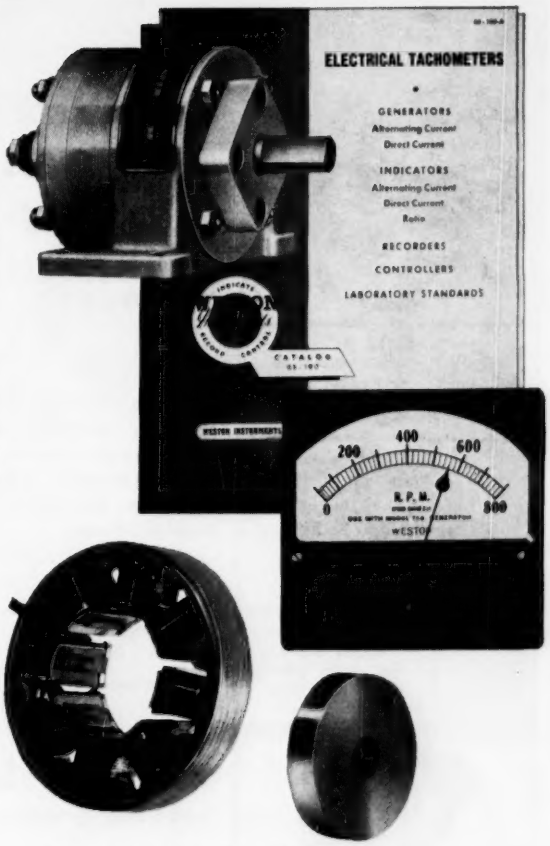


The Weston Catalog:

YOUR BEST "TACHS-ADVISER"

One look and you see why Weston Electrical Tachometers are a sound investment. Unequalled for simplicity of design, flexibility of application and reliability even under adverse conditions, this broad line of accurate, rugged, maintenance-free instruments can be fitted to existing or original equipment with equal ease.

For indicating, recording or controlling functions, in any combination . . . for measuring speed, speed ratio or speed differential, from 100 rpm to 100,000 rpm . . . for accuracies as high as ±1/10% . . . you'll find your best answer in Weston Catalog 03-100.

This catalog reveals full details of available units including A-C and D-C generators, self-contained and bearingless; variety of mountings; voltage-responsive and frequency-responsive networks; indicators, recorders, recorder-controllers and accessories.

For your copy, or for information about engineering assistance, get in touch with your local Weston representative, or write:

Daystrom-Weston Sales Division, Newark 12, N. J.
In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.

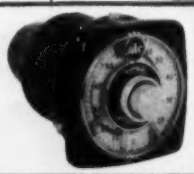
WESTON *Instruments*

A DAYSTROM UNIT

World Leader in Measurement and Control

CIRCLE 81 ON READER-SERVICE CARD

SERIES 305—Controls up to 6 individual load circuits; easily changed from "Reset" to "Non-Reset."



SERIES 306—Controls 2 separate adjustable load circuits; built-in dwell protects reversing motors.

SERIES 304—Percentage Timer; integral "On-Off" control eliminates separate switch.

SERIES 307—Revolution Counter; permits direct connection to flexible cables, differential couplings, gears, rotating shafts.

TIMERS FOR AUTOMATIC CONTROL

SPLIT SECONDS OR HOURS ACCURATE...RUGGED

Now you can order off-the-shelf timers for every industrial control application, including highly complex control functions involving hundreds of timed or sequential operations. ATC offers the widest line of standard timers, plus complete design and engineering assistance to meet special requirements. These unique features mean more dollar value from ATC timers:

Easy one-hole mounting in standard 3 3/16" cut-out. **Fully insulated ring clamp replaces screws.** **Change cycle any time with handy large knob.** **Cover slips off without disconnecting timer from service.** **One piece rolled cover has integral printed wiring schematic.**

Write now for new illustrated Condensed Catalog; contains complete specifications and performance data.

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AUTOMATIC TIMING & CONTROLS, INC.

KING OF PRUSSIA, PENNSYLVANIA

A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

CIRCLE 82 ON READER-SERVICE CARD

NEW INSTRUMENTS

4.5" PANEL INSTRUMENTS

New Models 1751 (D-C) and 1752 (A-C) rectangular-shaped 4.5" Panel Instruments are designed for mounting to ASA C39.1-1955 specifications. Features: molded bakelite bases and covers with glass windows, lance-type pointers, 4-inch, 100°-arc scales, and

the Weston Cormag self-shielding mechanism which permits instrument mountings in close proximity on magnetic or non-magnetic panels. Available as ammeters, milliammeters, microammeters, and voltmeters (1000 ohms per volt) with 2% accuracy (d-c) and 3% (a-c). Many ranges.—*Daystrom-Weston Sales Div., Daystrom Inc.*, 614 *Frelinghuysen Ave., Newark* 12, *N. J.*

CIRCLE 179 ON READER-SERVICE CARD

BATCHBOARD CONTROL

New method for Automatic Batching Control, "Batchboard" Remocon control, affords proportioning control opportunities through automatic presetting of unlimited numbers of batch formulas from a central re-

mote location. Each "Batchboard" is approximately 7" x 10" x 2" and contains contact holes, each representing a weight value. An individual "Batchboard" is used for each formula, and once the unit is wired, it can be used indefinitely without rewiring. As many as 20 ingredients can be controlled by one "batchboard".—*Toledo Scale Corp., Toledo* 13, *Ohio.*

CIRCLE 180 ON READER-SERVICE CARD

MARSHALLTOWN

DIAPHRAGM GAUGE FOR ACCURATE PRESSURE MEASUREMENT IN OUNCES OR INCHES OF WATER

Marshalltown Figure 83 is an extremely sensitive gauge that uses a carefully seasoned bronze diaphragm to accurately measure very low pressures. It is used extensively on many types of natural gas installations for checking low pressures.

Available in standard dials (reading in inches of water) 0-15" -0-30" -0-60" -0-100" -0-160" . . . also in ounce graduated dials from 15 ounces to 5 pounds. 2½", 3½" and 4½" dial sizes mounted in black enameled steel case.

Write for details and price. LOOK TO MARSHALLTOWN FOR ONE OF THE MOST COMPLETE LINES OF INDICATING PRESSURE GAUGES MADE!

MARSHALLTOWN MFG. COMPANY
MARSHALLTOWN 3, IOWA

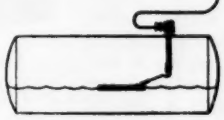
CIRCLE 83 ON READER-SERVICE CARD

100% AUTOMATIC TANK GAUGING

Dependable remote reading tank contents gauges using a closed hydraulic transmission system. No power required.

Several sizes available. Approved by Underwriters Laboratories and Factory Mutual. UL approved switches.

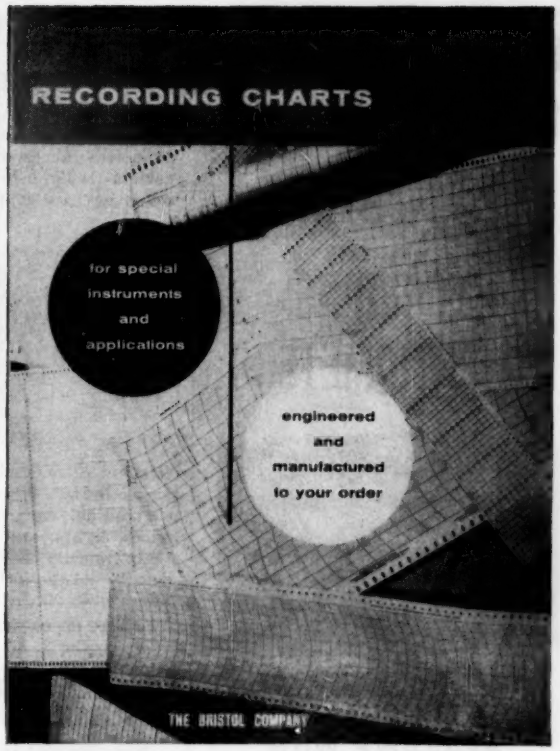
Write for complete details, to Dept. **E**



Since 1920 of proven quality

THE LIQUIDOMETER CORP.
LONG ISLAND CITY 1, NEW YORK

CIRCLE 84 ON READER-SERVICE CARD


RECORDING CHARTS
for special instruments and applications
engineered and manufactured to your order
THE BRISTOL COMPANY

new bulletin answers

chart problems

for new instrument designers

The new Bulletin Y1906 tells the story of Bristol's special chart designing and printing service.

It will help you with your new chart design and it will also give you some idea of the thoroughness with which Bristol is prepared to consider every aspect of instrument chart production from engineering to final printing. Naturally, as a special chart customer, you get the benefit of our 70 years of experience in designing and printing charts of all kinds for our own Bristol instruments as well as hundreds of instrument builders.

Strip charts up to 29⅛" across, circular charts to 12" diameter can be handled in Bristol's recently expanded chart pressroom. Highest quality standard chart papers are used, or "specials" like: papers for metallic marking, foil-type laminates, card stock, or heat and pressure-sensitive, carbon-coated, or photo-sensitive oscillographic papers.

Write us today for the complete Bristol chart story. Just ask for Bulletin Y1906. The Bristol Company, 154 Bristol Road, Waterbury 20, Conn. B-46

BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

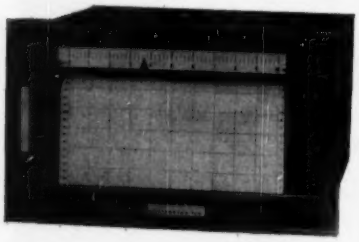
AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

CIRCLE 85 ON READER-SERVICE CARD

Where there's no margin for error...

westronics

RECORDING POTENTIOMETERS



11" CHART AVAILABLE WITH ONE or TWO PENS RECORDING FULL SCALE

FEATURING

SMALL SIZE

- Only 60% the size of old line instruments
- Designed for standard relay rack mounting

VERSATILITY

- Minimum span—1 MV
- Plug in range, MV or TC
- Chart drives, synchronous and/or selsyn, with large selection of speeds
- Marker pens, L and/or R
- Limit switches
- Transmitting slidewires

Also available: One and two pen 5" recorders

wi westronics® INCORPORATED

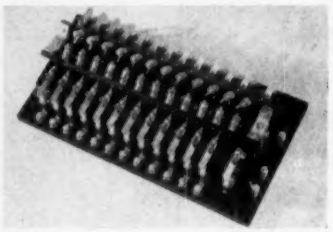
3605 McCART STREET • FORT WORTH, TEXAS

CIRCLE 86 ON READER-SERVICE CARD

NEW INSTRUMENTS

A-C RELAYS

New 25-amp mechanically-held A-C Relays are now available with up to 24 poles. Increased number of poles permits wide utilization as primary relay devices controlling contactors,

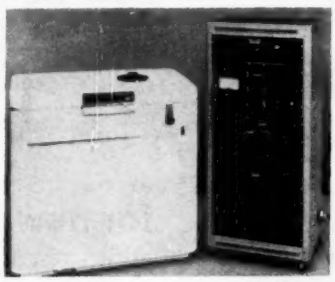


solenoid valves and similar equipment, or as branch circuit devices directly controlling electric ovens and furnaces, lights, and other loads within their capacity. Bulletin 1255-166 gives details.—*Automatic Switch Co., Florham Park, N. J.*

CIRCLE 181 ON READER-SERVICE CARD

LIQUID SCINTILLATION COUNTER

New low-cost semiautomatic Liquid Scintillation Counter LSC-10 performs precision analysis of low-energy beta emitters (i.e. C^{14} and



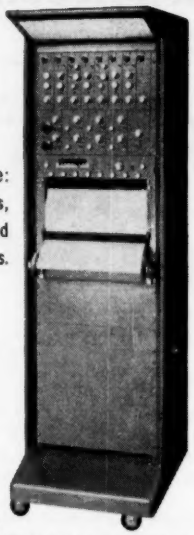
H^3). Consists of a compact top-opening deep freeze unit which contains the semiautomatic sample changing equipment, and a four-foot instrument console containing the associated electronic circuitry. The sample changer holds forty 20 ml glass sample vials. Bulletin No. 101 gives details.—*Tracerlab*, 1601 *Trapelo Rd., Waltham* 54, *Mass.*

CIRCLE 182 ON READER-SERVICE CARD

RELAY CONTROL AMPLIFIER

New compact relay control amplifier has a sensitivity of one μv and stability of $\pm$ one μv. Adapts to any type of control instrumentation where the transducer generates a change in voltage or resistance that is representative of the measured variable, including, "go/no-go" quality control system. Amplifier is a high-gain d-c-to-a-c amplifier which recognizes the polarity of a low-level d-c input sig-

OFFNER All Transistor

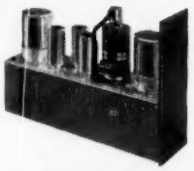


Models available: 1 to 19 channels, console, rack, and portable assemblies.

TYPE R DYNOGRAPH

A direct-writing oscillograph with unmatched features of superiority! Whatever your application for direct-writing recording, the Offner Type R All Transistor Dynograph will do your job *better* and more *easily*. Write on your letterhead for literature and complete specifications.

TYPE 190 *Differential* DATA AMPLIFIER



Zero-drift d-c amplifier with 1/100% accuracy. Linearity of better than 0.05%. Gain stability of 0.01%. Ripple of less than 0.1%. Infinite rejection of common d-c signals. Rapid response to step input. Ambient range −67°F to 170°F. Ask for Bulletin 572.

Type 542 Two-Channel DYNOGRAPH

Rapid response, high sensitivity, stability, compact construction, economical price—all features that make this all transistor, 2 channel unit ideal as a test instrument . . . practical for use at every laboratory bench. Ask for Bulletin 181.

OFFNER ELECTRONICS

3910 River Road, Schiller Park, Ill.
(Suburb of Chicago)

CIRCLE 87 ON READER-SERVICE CARD

NEW FULL-VIEW® ROTAMETER

Interchangeable metering tubes snap in and out . . . in seconds! It's that easy to change range or to service the new Brooks Series 1112 Full-View Rotameters.

A stainless steel leaf spring (entirely isolated from the process fluid) holds the tube perfectly in position, yet allows removal with just a simple up-and-out movement. No tools necessary.

Special O-ring construction and tube adapter assemblies make this time-saving convenience possible. Up to four different size metering tubes may be interchanged in a single case by merely changing adapters.

Like all Full-View Rotameters, the new Series 1112 features Brooks' dowel-pin, side-plate case construction. Thoroughly proven in service, this practical construction gives the meter case rigid strength, protects the glass metering tube from all line strain.

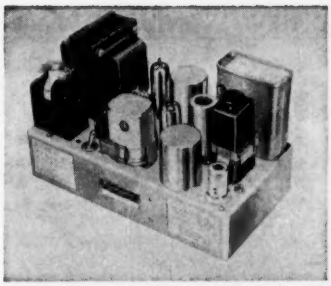
For More Information, Request Design Specification Sheet SS-111-2

BROOKS ROTAMETER COMPANY

1059 J STREET, LANSDALE, PA.

S.A. 1037

CIRCLE 88 ON READER-SERVICE CARD

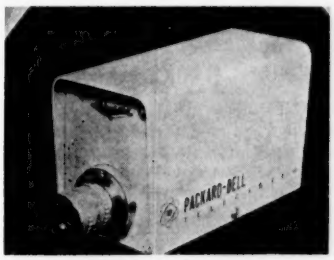


nal, converts it to a-c, and amplifies it to a signal with sufficient strength to actuate its master relay in accordance with that polarity. Operating power supply is 115 v, ±10; 50 to 60 cps. Amplifier weight 6.5 lb.—*Thermo Electric Co., Inc., Saddle Brook, N. J.*

CIRCLE 183 ON READER-SERVICE CARD

ITV

New closed-circuit Television Camera provides detail in excess of 600-line resolution, has single operating control, automatic light com-

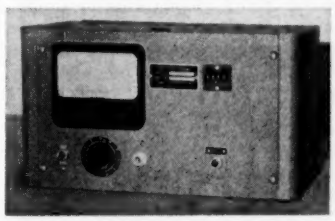


pensator. Remote accessories: pan and tilt unit, auto-zoom lens, remote control turrets, and an air conditioned weatherproof housing with windshield wiper.—*Packard Bell Service Div., 1920 S. Figueroa St., Los Angeles 15, Calif.*

CIRCLE 184 ON READER-SERVICE CARD

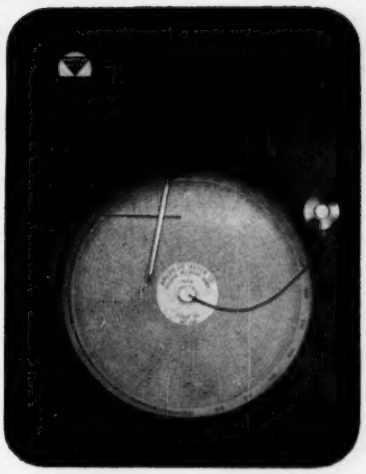
WIRE FAULT RELAY

New "Wire Sparker" a low-cost electronic Fault Relay, has a-c or d-c output. Features: speeds up to 2000 ft/min. with 5" electrode, (400



fpm per 1" of electrode); suitable for extruder or respooler use. Provides fast, accurate indication of faults, even at very low output voltages, (a typical 14 kv d-c Sparker will work at 700 v.—*Peschel Electronics, Inc., RFD #1, Patterson, N. Y.*

CIRCLE 185 ON READER-SERVICE CARD



AMERICAN®

PRESSURE and TEMPERATURE RECORDERS

American® single and two-pen *Pressure Recorders* for pressures from 30 inches vacuum to 10,000 psi.

- Pressure elements individually calibrated over full range.
- Variety of chart drives available.
- Helical elements of different ranges are interchangeable.
- Stainless steel pen arms with span and linearity adjustments.
- Aluminum dust and moisture-proof case.

American® *Temperature Recorders* for an accurate record of flowing temperatures.

- No ambient temperature errors.
- High sensitivity and torque—fast speed of response.
- Standard 0-150°F. range. Other ranges available by request.
- 24-hour mechanical or 110-v. 60-cy. electric chart drives.

Ask for Bulletins 400 and 408

AMERICAN® METER COMPANY

INCORPORATED (ESTABLISHED 1836)

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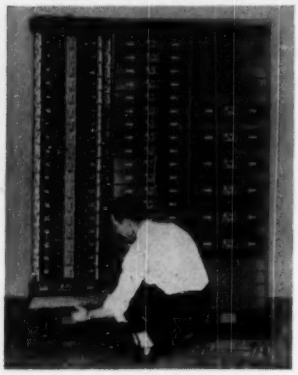
CIRCLE 89 ON READER-SERVICE CARD

UP TO
37 CHANNELS IN THE Voice Band
(300 to 3000 CPS)



with Comvor®
DATA TRANSMISSION TERMINAL

RFL Model 912
Operates over Wire Circuit or Microwave

•

Reliable HIGH-SPEED Continuous Control
of
PUMPS
VALVES
MOTORS
GENERATORS
RELAYS
ETC.

The Model 912 Comvor, an audio frequency shift terminal, is used in the transmission of telemeter, telegraph or control signals over either wire line, microwave, or carrier. Up to 90 individual information channels are available in the audio spectrum.

Reliable frequency shift method of keying is used. All essential controls such as transmitter output level and receiver input level are included.

Each terminal contains its own power supply which provides an additional 60 milliamperes at both the transmitter and receiver for the operation of relays, stepping switches, selector magnets, and other components used in telemetering, control and telegraph applications.

WE CAN HELP YOU
Our Applications Department is ready to assist you in your control, telemetering or communications problem. Phone DEerfield 4-3100.

Write for Technical and Application Data.

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

CIRCLE 90 ON READER-SERVICE CARD

NEW INSTRUMENTS

VALVE TEST BENCH

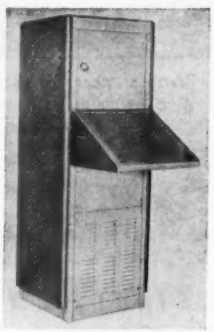
New Valve Test Bench is designed for pressure testing of all types of valves. Has two test plates: one for ½" thru 2" screwed valves and 8" thru 10" flanged valves, and one for

2½" thru 6" flanged valves. Two different valves may be tested at the same time, with either gas or liquid within a pressure range of 0 to 1000 psi on the standard valve test bench. —*Piping Engineering Co.*, 2010 *S. Utica, Tulsa, Okla.*

CIRCLE 186 ON READER-SERVICE CARD

RACKS

New F-Series line of Prem-O-Rak Modular Transmitter Racks is designed for multiple installations and for use with the Prem-O-Rak con-



sole cabinets. Doors, end panels, flush doors, shelves and turrets are available as accessories for modular systems.—*Premier Metal Products*, 337 *Manida St., New York* 59, *N. Y.*

CIRCLE 187 ON READER-SERVICE CARD

SCINTILLATION DETECTOR

New Model D5-12 Scintillation Detector will drive up to 500 feet of cable without an auxiliary preamplifier or power source. Provides an integral transistor preamplifier circuit

MINIATURE MANIFOLDS
for
Multi-Purpose CONTROL

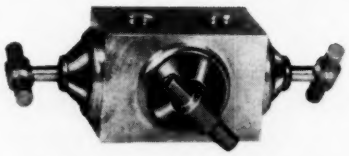


Photo ½ actual size

PACKLESS
"DEMI"
M2 SERIES

All models of the standard Dahl "Demi" M2 series of three-valve manifolds are readily adaptable to clean liquid, gas and vapor applications. The size of these manifolds makes them especially suitable for pilot plant, aircraft and marine applications, flow control and automation. They are miniature in size, yet their patented form for bubble-tight shutoff makes them comparable to much larger valves in performance.
These manifolds consist of two block valves and one bypass valve in place of 3 separate valves . . . they eliminate two tees, four nipples and eight threaded connections. Models of the "Demi" M2 series come in a variety of barstock materials and may be ordered with special features such as: bolted bonnets, swaged-in TEFLON seats, toggle actuators, etc.

PRESSURE RATING Metal Body & Diaphragm Neoprene Diaphragm	 750 psi at 450°F 100 psi at 180°F
MAXIMUM Cv	0.4
CONNECTIONS	1/16", 1/8", 1/4" N.P.T.

Send for the "DEMI" Catalog D-1 and other technical data on Dahl pneumatic and hydraulic valves.

GEORGE W.
DAHL
COMPANY, INC.
86 TUPELO STREET, BRISTOL, RHODE ISLAND

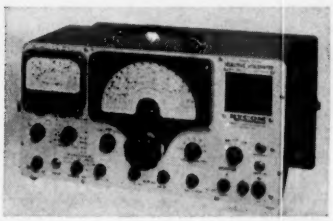
CIRCLE 91 ON READER-SERVICE CARD

which operates on a small part of the voltage supplied to the photomultiplier. Can be used with counting instruments that are not equipped for the connection of accessories such as the extra preamp.—Interchangeable aplha, beta and gamma detector crystals are available.—*Technical Measurement Corp.*, 441 *Washington Ave., N. Haven, Conn.*

CIRCLE 188 ON READER-SERVICE CARD

FREQUENCY-SELECTIVE VOLTMETER

New Model 2174A Selective Voltmeter employs the heterodyne principle with balanced modulation. Makes amplitude measurements throughout the frequency spectrum of 300 cycles to 400 kc. Uses highly-selective crys-

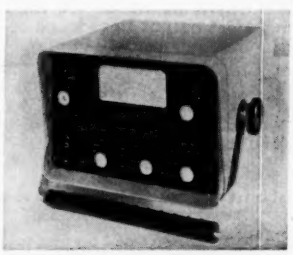


tal filters to achieve the resolution necessary for amplitude measurements of microwave subcarrier, wire line communications and subcarrier telemetering systems. Features include a gear-driven dial mechanism, a balanced input transformer with circuits provided for 135 ohm, 600 ohm or bridging inputs.—*Rycom Instruments*, 9351 *E. 59 St., Raytown* 33, *Mo.*

CIRCLE 189 ON READER-SERVICE CARD

TRANSISTORIZED VOLTMETER

New series Model R-3 Transistorized Voltmeter measures a-c voltage from 1 mv to 1000 v full scale in 14 ranges over a 10-cps to 200-kc frequency range; + and — d-c voltages from 1 v to 1000 v full scale in 7



ranges; electrometer input from 0 to 1 vdc and center-scale resistances from 10 ohms to 10 megohms in seven steps. Overall accuracy is now better than 3% on all voltage readings.—*Southwestern Industrial Electronics Co.*, 10201 *Westheimer Rd., P. O. Box* 13058, *Houston* 19, *Texas.*

CIRCLE 190 ON READER-SERVICE CARD

lightest weight/easiest installation/silent no hum operation

NEW HOKE

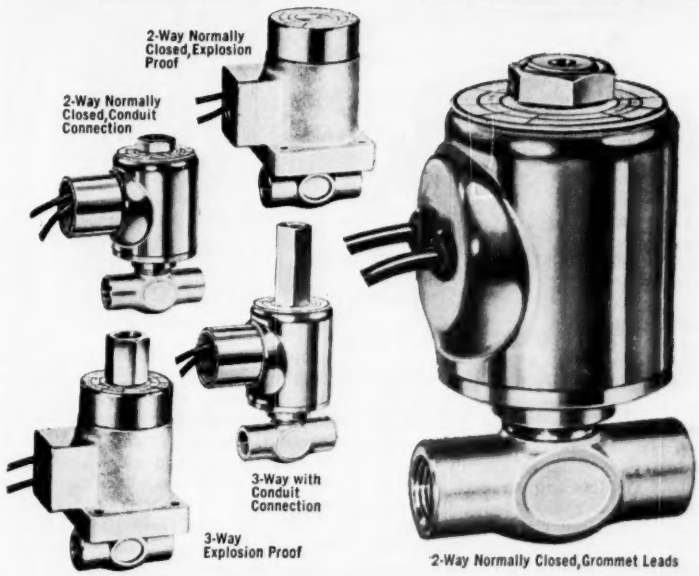
lowest temperature rise and power consumption

SOLENOID

stainless steel plunger design/silver ac shading coil

VALVES

smallest size/packless construction/operates any position


2-Way Normally Closed, Explosion Proof
2-Way Normally Closed, Conduit Connection
3-Way with Conduit Connection
3-Way Explosion Proof
2-Way Normally Closed, Grommet Leads

The lightest, smallest direct-acting solenoid valve available, featuring many innovations in design plus the usual, high-quality standards of all Hoke products. Two-way and three-way types (Series 90 and Series 95), with brass or stainless steel bodies are in production, in standard female connection sizes: ⅛" and ¼" as well as ¼" OD tube, 37° flare. Orifice sizes from 1/32" to ⅛". Mount in any position; a 360° rotatable coil housing permits connections from any angle. Choice of materials for valve discs and body gaskets. Variations in basic design to fit your needs. Competitively priced!

HOKE

Complete specifications, ordering information, etc., are included in bulletin No. SV-559. Send for your copy.

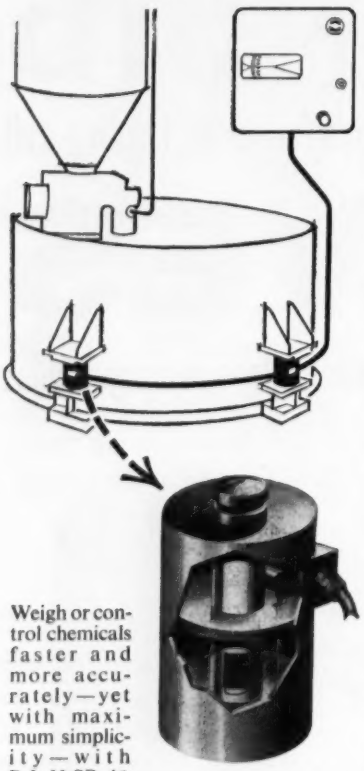
Fluid Control Specialists

HOKE INCORPORATED, 31 PIERMONT RD., CRESSKILL, N. J.

CIRCLE 92 ON READER-SERVICE CARD

MEASURING QUANTITY?

Then do it the modern way ... with accurate, rugged, trouble-free SR-4® Load Cells



Weigh or control chemicals faster and more accurately—yet with maximum simplicity—with B-L-H SR-4® Load Cells. Installed as part of the tank support structure, no part of the measuring system comes in contact with the contents of the tank. Can be installed on tanks already in use. Output suitable for use with local or remote indicator, recorder or automatic dispensing control. Explosion-proof. Hermetically sealed—unaffected by dust, grease or moisture; long service life assured. Available in standard capacities of 50 through 200,000 lb., accuracies to ±0.10%.

For more information on load cells and complete batching systems, write Dept. 7-J and ask for Bulletins 4355 and 4510

FIRST in force measurement

SR-4 BALDWIN BLH LIMA-HAMILTON

BALDWIN·LIMA·HAMILTON

Electronics & Instrumentation Division
Waltham, Mass.
SR-4® Strain Gages • Transducers • Testing Machines

CIRCLE 93 ON READER-SERVICE CARD

NEW INSTRUMENTS

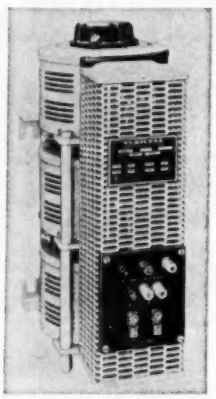
HIGH-TEMPERATURE PROBES

New series of resistance probes measures the temperature of non-corrosive gases or dry chemicals up to 800°F. Can also be inserted directly in rolls or platens. Resistance-temperature characteristics are similar to the MH series of RdF Stikons. Steel sheath provides mechanical protection. Custom high temperature probes available on special order.—*Arthur C. Ruge Associates, Inc., Hudson, N. H.*

CIRCLE 191 ON READER-SERVICE CARD

A-C/D-C POWER SUPPLY

New Varicell adjustable A-C/D-C Power Supply consists of a 3-phase, low-voltage Powerstat variable transformer combined with a static d-c power supply using silicon cells connected for 3-phase operation. Ripple



content is approximately 4.2% and ripple frequency 360 cycles at a supply frequency of 60 cycles. Input is 240, 3-phase (primary delta connected). A-c output can be either 0-30 v, 40 amp (secondary delta connected) or 0-50 v, 25 amp (secondary wye connected). D-c output can be either 0-35 v, 50 amp (secondary delta connected) or 0-60 v 30 amp (secondary wye connected). Regulation is approx. 10%. Details in Bulletin V359. —*Superior Electric Co., Dept. V4050, Bristol, Conn.*

CIRCLE 192 ON READER-SERVICE CARD

DIGITAL PRINTER

New high-speed Digital Printer, Model 3303, completely transistorized, features print-out rates in excess of 10 lines/sec and custom designed format with choice of number of columns up to 20 and type of characters or symbols. Storage and programming electronics are offered in a separate housing. Any character coding or single line control can be employed

Vi ... solid state galvanometer driver amplifier

... especially designed to "FILL THE GAP" between low power voltage sources and high frequency galvanometers requiring up to 100 milliamperes of driving power.

Typical voltage sources are high gain DC amplifiers, telemetering receivers, demodulators, detectors, oscillators, transducer-demodulator combinations, etc.

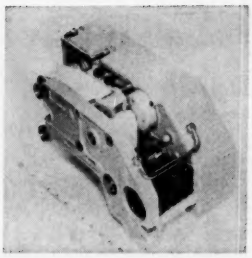
This unit, Model 92, is also useful as a programmed power supply. When connected to a reference cell (which is incapable of delivering sufficient current for many applications), it will faithfully reproduce the cell's voltage while delivering up to 100 milliamperes at at output impedance of less than one ohm.

Priced at $150.00 each (f.o.b. Santa Monica, California), the Model 92 provides the necessary galvo driving power at a very low cost to your instrumentation system.

Input	Single ended; isolated from case
Input Impedance	Greater than 100,000 ohms
Output	±10 volts at 100 ma.
Total Noise and Hum	Less than 3 mv peak to peak
Bandwidth	DC to 10 KC ±1 db.
DC Linearity	0.2%
Long Term Stability	When used with galvanometers having a maximum sensitivity of one inch per volt, drift and noise are not distinguishable on the record.
Power Requirements	115V ±20V, 50 cps to 400 cps, 8 watts maximum.

VIDEO INSTRUMENTS CO., INC.
3002 Pennsylvania Ave., Santa Monica, Calif.

CIRCLE 94 ON READER-SERVICE CARD



to control printer. Pressure-sensitive paper is used. Custom designs are available. Dimensions: 8½" x 8" x 15⅞", and 34 pounds in weight.—*Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, L. I., N. Y.*

CIRCLE 193 ON READER-SERVICE CARD

ELAPSED TIME INDICATORS

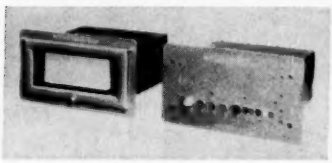
New line of sub-miniature hermetically-sealed Elapsed Time Indicators operate on 115-v 60-cps supplies (complementing earlier line of 400-cps units). Three basic models are offered. Digital model has 5 digits

reading to 9999.9 hours in tenth-hour increments. Two-dial type models are offered: one reading to 2500 hours in 5 hour increments and one reading to 10,000 hours in 10 hour increments. All models use a miniature 60-cycle motor drawing less than three watts. Details in Bulletin ET-603.—*A. W. Haydon Co., Waterbury, Conn.*

CIRCLE 194 ON READER-SERVICE CARD

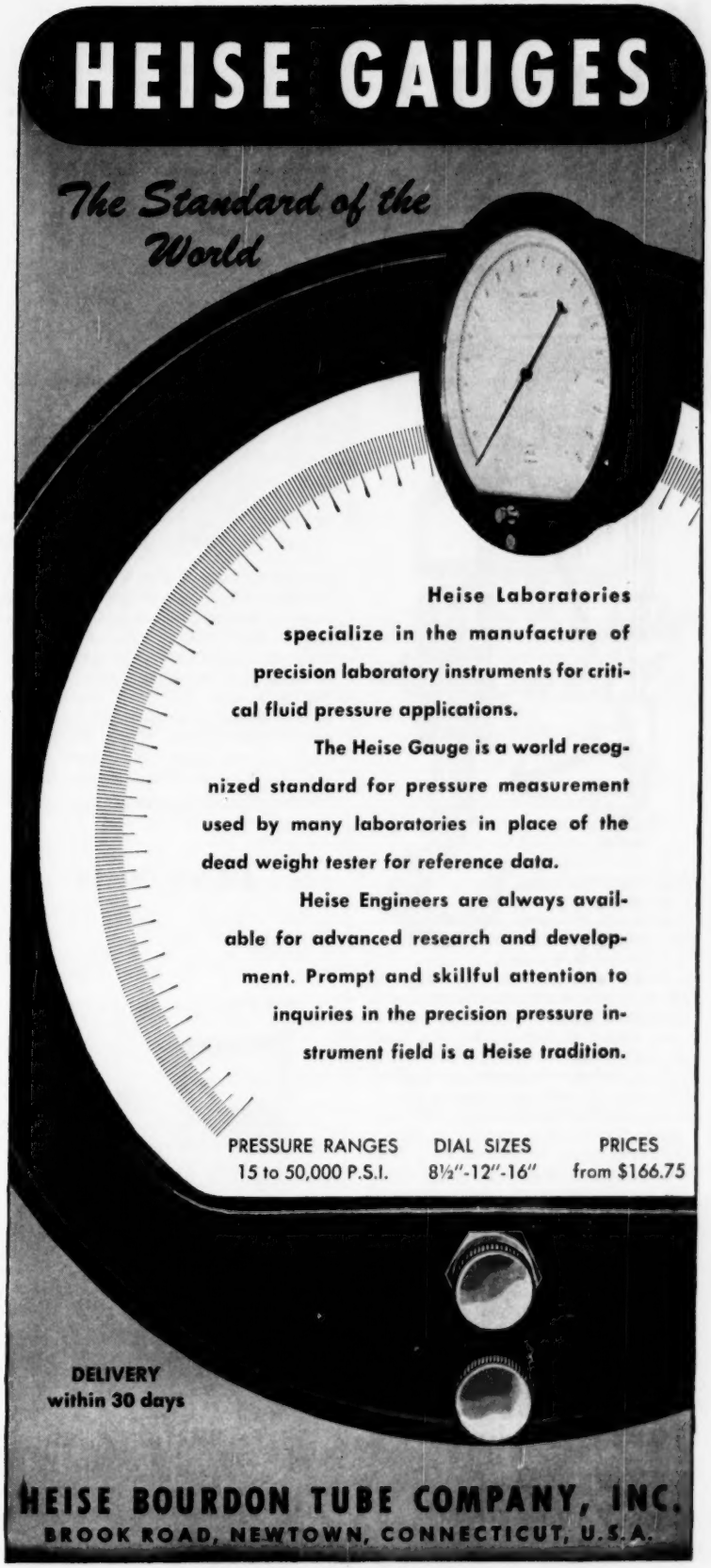
OPERATIONS RECORDER

New rugged Operations Recorder operates only on a change in the incoming signal in either the analog or digital channels. Features: 6 off-on channels and 1 analog (digitized) channel. Chart is 3¼" wide. Marking



is produced by fixed styli, each excited from its controller. Starting time is 19 msec to reach 63% of operating speed. Frequency response is 0-600 cps for the analog (digitized) channel and 0-200 cps on the off-on channels. Accuracy is ± 2.5% for analog channel, marked with fifty digits peak-to-peak at maximum deflection.—*The Hamilton Watch Co., 5800 East Jewel Ave., Denver 22, Colo.*

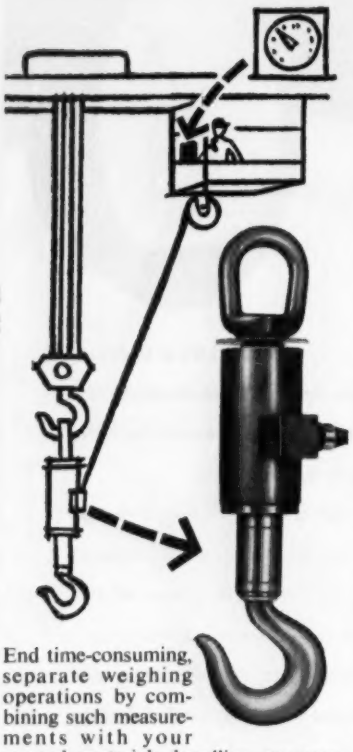
CIRCLE 195 ON READER-SERVICE CARD


HEISE GAUGES
The Standard of the World
Heise Laboratories specialize in the manufacture of precision laboratory instruments for critical fluid pressure applications.
The Heise Gauge is a world recognized standard for pressure measurement used by many laboratories in place of the dead weight tester for reference data.
Heise Engineers are always available for advanced research and development. Prompt and skillful attention to inquiries in the precision pressure instrument field is a Heise tradition.
PRESSURE RANGES
15 to 50,000 P.S.I.
DIAL SIZES
8½"-12"-16"
PRICES
from $166.75
DELIVERY
within 30 days
HEISE BOURDON TUBE COMPANY, INC.
BROOK ROAD, NEWTOWN, CONNECTICUT, U.S.A.

CIRCLE 95 ON READER-SERVICE CARD

MEASURING WEIGHT?

Save handling time with easy-to-install, remote-indicating SR-4® Crane Scales



End time-consuming, separate weighing operations by combining such measurements with your normal materials handling program. SR-4® Crane Scales provide you with accurate inventory control information—on remote dial or printer type indicators—while materials are being moved. SR-4® Crane Scale sensing elements contain no moving parts; require no maintenance; and are unaffected by dirt, grease, water or corrosive fumes. Connection to indicator consists of only a light, flexible electrical cable. Accuracies guaranteed to ±0.2% of capacity. Available for immediate delivery in various capacities from ½ through 25 tons.

For 12-page Bulletin No. 4513 write Dept. 7J

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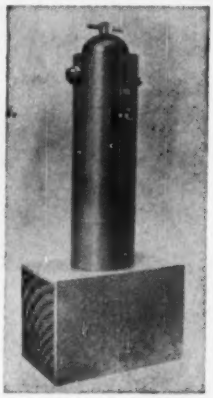
BALDWIN·LIMA·HAMILTON

Electronics & Instrumentation Division
Waltham, Mass.
SR-4® Strain Gages • Transducers • Testing Machines

CIRCLE 96 ON READER-SERVICE CARD

AIR DRYER

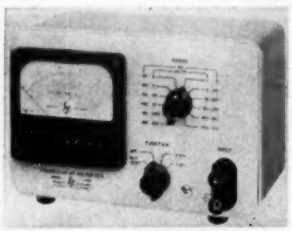
New Refrigifilter, a refrigerated unit to safeguard pneumatically-operated equipment from all forms of moisture, oil, and contaminants (especially designed for locations where cooling water is unavailable or where the ambient day-night temperatures vary a great deal) lowers the dew point of compressed air to approximately 35°F at pressure, thus condensing out over 90% of all moisture/oil vapors and removing all entrained liquids. Rated 100 scfm at 100 psig and 100°F, it combines a heat-exchanger, evaporator, refrigerating section, and filter element in one compact unit.—*Hankison Corp., College & Pike, Canonsburg, Penna.*



CIRCLE 196 ON READER-SERVICE CARD

A-C VOLTMETER

New Voltmeter, Model 403A, is a transistorized, compact instrument weighing less than 5 pounds. Frequency range is 1 cps to 1 Mc. Measures a-c voltages from one mv full scale to 300 v full scale. Has 12 voltage ranges and also reads db from −72 to +52 db.—*Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif.*

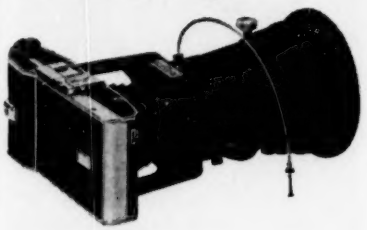


CIRCLE 197 ON READER-SERVICE CARD

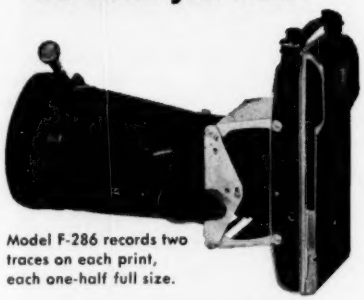
PNEUMATIC SWITCH

New Model J-1 S-1 VP Tandem Magnetrol Head combines a two level stage switching action to provide an electrical switch mechanism (S-1) in a vapor-proof and explosion-proof

Model F-296 makes full-size photo record of single transients or identical repetitive phenomena.



With these Fairchild-Polaroid® Oscilloscope Cameras you can...



Model F-286 records two traces on each print, each one-half full size.

PERMANENTLY RECORD OSCILLOSCOPE TRACES in 20 to 60 seconds!

No special photographic skills are needed with a Fairchild-Polaroid Oscilloscope Camera. Two models are available. One records single, direct-reading, full-size scope images; the other two half-size images on one print. Operation of both is fast and simple, hardly interrupts lab procedures. You can evaluate prints directly in one minute or less, enter photo evidence into reports at once.

For descriptive literature, write to Industrial Products Division, Dept. 19, Fairchild Camera and Instrument Corp., 5 Aerial Way, Syosset, L. I., N. Y.

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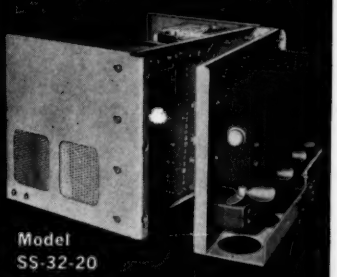
CIRCLE 97 ON READER-SERVICE CARD

sig-

nificantly!

Every NJE Solid State Transistorized Power Supply is built with components that are significantly derated under the most severe combination of line, load and ambient conditions. Components are the highest quality military and commercial types available (every transformer and choke is a MIL-T-27A style unit, every resistor is wire-wound). Proven reliability makes NJE your best Power Supply buy! 14 standard models cover virtually every job. Here's one:

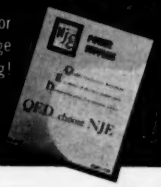


Model SS-32-20

Output, volts: 0-32.
Output, amps: 0-20.
RMS ripple: 1 millivolt.
Regulation, load: ±0.015% or ± 1 MV.
Regulation, line: ±0.03% or ± 2 MV.
Internal Impedance DC-20KC: 0.02 ohms.

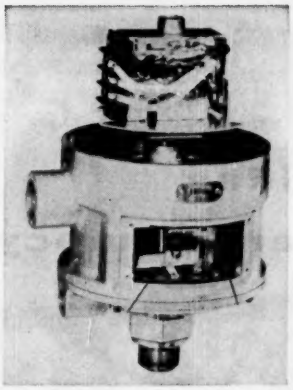
PRICE: $990
FOB Kenilworth, N. J.

Write today for this new 16 page Power Supply catalog!



NJE CORPORATION
20 Boright Ave., Kenilworth, N. J.
Br 2-6000

CIRCLE 98 ON READER-SERVICE CARD



switch housing mounted physically over a pneumatic (J-1) switch mechanism which is splash-proof in its construction. Head can be so set up that either electric or pneumatic action can be secured as the first stage on rising (or falling) level regardless of the physical positioning of each mechanism. Uses either air or gas as operating pressure medium. Available with all styles of Magnetrol actuators—top or side mounting with either threaded or flanged connections.—*Magnetrol, Inc.*, 2110 *South Marshall Blvd., Chicago* 23, *Ill.*

CIRCLE 198 ON READER-SERVICE CARD

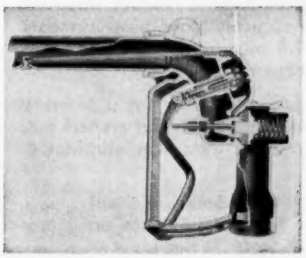
GAS FLOW COMPUTER

New all-electric Gas Flow Computer continuously measures mass flow of gas under standard conditions. Comprises differential-pressure transmitter, an absolute-temperature sensing device, an absolute-pressure transmitter, an analog computing circuit, and an electronic circular or strip-chart recorder.—*Brown Instruments Div., Minneapolis-Honeywell, Wayne & Windrim Aves., Phila.* 44, *Pa.*

CIRCLE 199 ON READER-SERVICE CARD

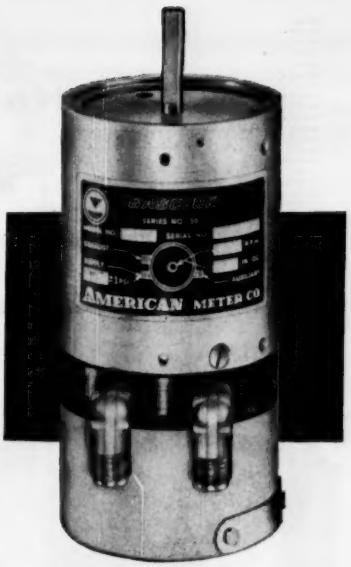
LIQUID LEVEL CONTROL

New patented Sliding Gate and Plate Regulators for liquid level control use plant air to pilot main diaphragm control valve. Feature



tight shut-off and accurate control from 1 to 2500 gpm capacity. Available in ¼" through 6" sizes. Used where critical liquid level control is needed. Details in SRBc 37-59 and Bulletin J-170.—*OPW-Jordan*, 6013 *Wiehe Rd., Cincinnati* 13, *Ohio.*

CIRCLE 200 ON READER-SERVICE CARD



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Completely self-contained gas or air-powered instrument driving and timing unit for long, trouble-free operation in remote locations. The GASCLOK delivers more than 20 times the torque of conventional spring-wound mechanisms. Continuous timing accuracy is unaffected by a ± 20% variation in supply pressure.

Inherently explosion proof and self-starting, the GASCLOK is ideal as original or replacement equipment for strip chart and conventional circular chart instruments. The timing mechanism is internally sealed to prevent corrosion, and all power unit parts exposed to gas are aluminum or stainless steel. Large area internal ports prevent clogging. Normal air or gas consumption 5 cfh . . . operating pressure 5 psi . . . rotation 2 rpm.

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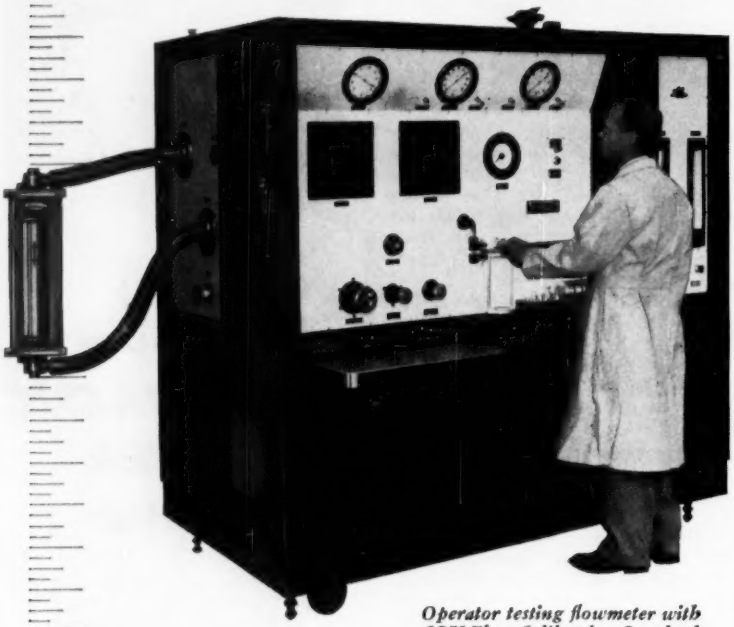
CIRCLE 99 ON READER-SERVICE CARD

How UNION CARBIDE Verifies Flowmeter Accuracy



Operator testing flowmeter with COX Flow Calibration Standard

Periodic checking of liquid flowmeters at the huge Oak Ridge, Tennessee nuclear facility presented a problem to the Union Carbide Nuclear Company, operators of the facility. Checking the instruments required a known standard against which they could be evaluated. Using other flowmeters as masters was of questionable value as they too were subject to the same variables of wear, temperature changes, and viscosity shifts as were the instruments under test.

Union Carbide solved the problem by using a *COX Flow Calibration Standard* (Type 315), the same as those used by flowmeter manufacturers for original instrument calibration. It gives them a *primary standard* of their own — assuring accurate flow measurements that can be correlated with measurements by the National Bureau of Standards.

Costly? Not as much as you'd think for a *primary standard*. And the time normally spent on rechecking, evaluations, and analyzing test data was eliminated.

If you make or use flow measuring devices you will be interested in our new Technical Bulletin on *COX Flow Calibration Standards*. Write to: *Cox Instruments Division, George L. Nankervis Company, 15400 Fullerton Avenue, Detroit 27, Michigan.*

IF IT'S WORTH MEASURING
It's worth measuring accurately 7392

COX Instruments

CIRCLE 100 ON READER-SERVICE CARD

BOILER GAGE

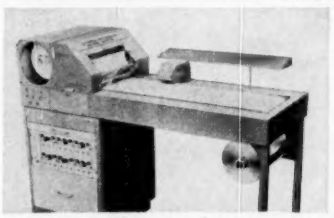
New "Refragage" uses light refraction to give black and white reading for high-pressure boilers. Flood-light illuminator at back of gage passes light rays through an angular pass-

age, and while the light passing through the water is refracted and lost to view, the light passing through the steam area shines brightly through the front line of holes above the water level.—*Jerguson Gage & Valve Co., 80 Adams St., Burlington, Mass.*

CIRCLE 201 ON READER-SERVICE CARD

RECORDER

New six-channel Recorder fills need for a recorder which allows user to obtain a view of the oscillogram and make notes or corrections with the oscillogram in motion. Unique



feature: oscillogram is transported on a belt along the top of the readout table allowing the operator a full and undisturbed view of nearly three feet of record. Oscillogram width—up 12 in. oscillogram speed—between 1 to 50 mm/sec.—*The Gerber Scientific Instrument Co., 89 Spruce St., Hartford 1, Conn.*

CIRCLE 202 ON READER-SERVICE CARD

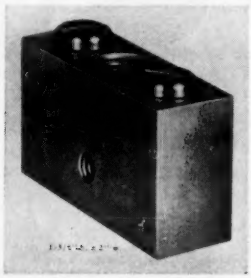
PULSATION ABSORBER

New Type No. 6 is essentially three instruments in one—Snubber, Seal Pots and Syphon. Prevents shock and pulsations that damage and prevent inaccurate reading on gages, recorders, etc. It absorbs and irons out shock and pulsations before reaching the instrument.—*Defender Instrument & Regulator Co., Boody, Ill.*

CIRCLE 203 ON READER-SERVICE CARD

DOUBLE BALL CHECK VALVE

New miniature Double Ball Check Valve features a separate ball for each inlet. If both supply pressures



fail, the two inlets are immediately sealed, preventing bleed-off of downstream pressure.—*George W. Dahl Co., Inc., 86 Tupelo St., Bristol, R. I.*

CIRCLE 204 ON READER-SERVICE CARD

SHAFT-ANGLE DIGITIZER

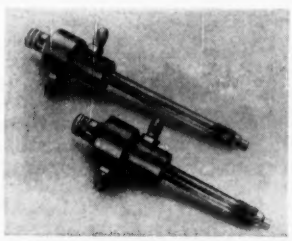
New Dychroverter Model DV-13D Shaft-Angle Digitizer comprises optical-mechanical converter of only 25 in^3 and an amplifier assembly of 37 in^3. A cable up to 3-feet in length carries the 13-digit reading signals

from converter head at the point of measurement to 13 separate amplifier channels. Angle reading is at a rate of 100 complete digital words/sec and to an accuracy of ±2.5 min. —*Dychro Corp., 12 Centre Ave., Newton 58, Mass.*

CIRCLE 205 ON READER-SERVICE CARD

PRESSURE TRANSDUCER

New Dynisco Model PT58 Pressure transducer has response, resolution, and performance necessary to measure small and rapid pressure fluctuations in the plastic melt during the extrusion process. Features: repeatability of 0.1%, operating temperatures of 750°F. Units are available



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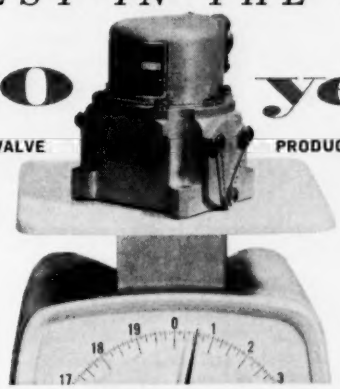

MI SERIES 40 SERVOVALVES

ONLY 9.5 OUNCES

DEPENDABLE

Large control orifices, clearances, and high driving forces (½ system pressure with 10% rated current) insure long life and maximum reliability.

MECHANICAL FEED BACK
LOW HYSTERESIS: 2%

Featuring simplified design, the Midwestern Model 40 Series Servovalves have been tooled for production to meet existing and anticipated reliability requirements of military applications. Special effort has been made to lighten weight, improve hysteresis, decrease leakage and reduce susceptability to oil contamination.

Various configurations of the Model 40 are available for three-way or four-way service.

DYNAMICS: Amplitude — 3 db max. at 150 cps.
Phase — 90° at 150 cps. max.
TORQUE MOTOR: Dry gap and coils, hermetically sealed.
LEAKAGE: External, none. Internal, .09 gpm max. (to drain)
RATED FLOW: To 5.0 gpm at 1000 psi valve drop.

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Oscillographs
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Complete FM Ground Station Telemetering Systems

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Fast Response

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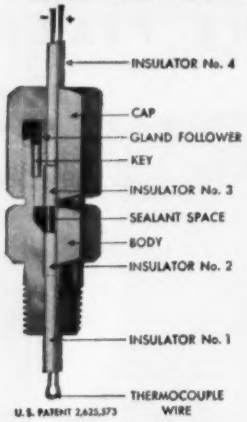
BARE WIRE THERMOCOUPLE GLANDS



provide the only simple positive method for sealing two or more bare wires at pressures from full vacuum to 20,000 psi.

Low mass, unshielded, bare wire thermocouples give almost instantaneous response to temperature changes assuring greater accuracy of measurement and control.

- **Temperature range— −300°F to +1850°F**
- **All stainless steel construction**
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automatic engine controls

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d.c. solenoids
relays and contactors
speed sensitive switches (1, 2 & 3 element)
special control panels
liquid temperature switches
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For Highest Precision and Dependability

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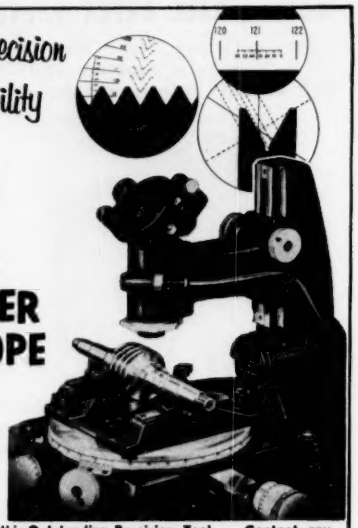
LARGE TOOLMAKER MICROSCOPE



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11" Diameter Built-in Rotary Table
Indexing Full 360°

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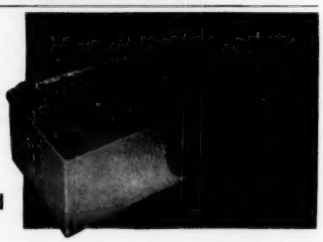
CIRCLE 104 ON READER-SERVICE CARD

PORTABLE... ACCURATE... EASY TO OPERATE...

Sprengnether's Blast and Vibration Seismograph



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Typical Applications:

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- Determine Vibration Response of Members During Construction and After Completion of Building.

Portability: (38 lbs.—25 x 10 x 8 in.) Unit is self contained and free from external power source.

Extremely Accurate: To guard against error, each instrument is tested and calibration data furnished. Frequency response, 3 to 200 cycles per second. Timing lines are across record at intervals of 0.02 seconds with accuracy of 0.1%.
Easy To Operate: All controls are easily accessible. Instrument can be set up, leveled and made ready to operate within minutes.

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CIRCLE 105 ON READER-SERVICE CARD

for the complete pressure range of 0-1000 to 0-10,000 psi.—*Dynamic Instrument Co., Inc., 42 Carleton St., Cambridge 42, Mass.*

CIRCLE 206 ON READER-SERVICE CARD

RESISTANCE PRESSURE DETECTOR

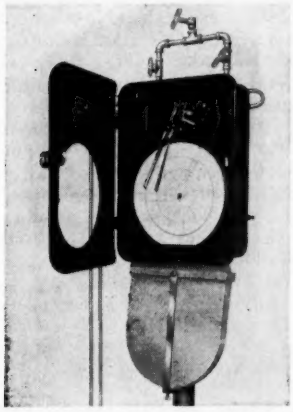
New Resistance Pressure Detector, Model 328, can measure gas, fluid or vapor pressures in combination with "Omniguard" monitor; converts

pressure directly to electrical resistance. Features: rugged, accurate, reliable yet inexpensive. Ranges from in Hg to 3000 psig.—*Instrument Div., Thomas A. Edison Industries, McGraw-Edison Co., West Orange, N. J.*

CIRCLE 207 ON READER-SERVICE CARD

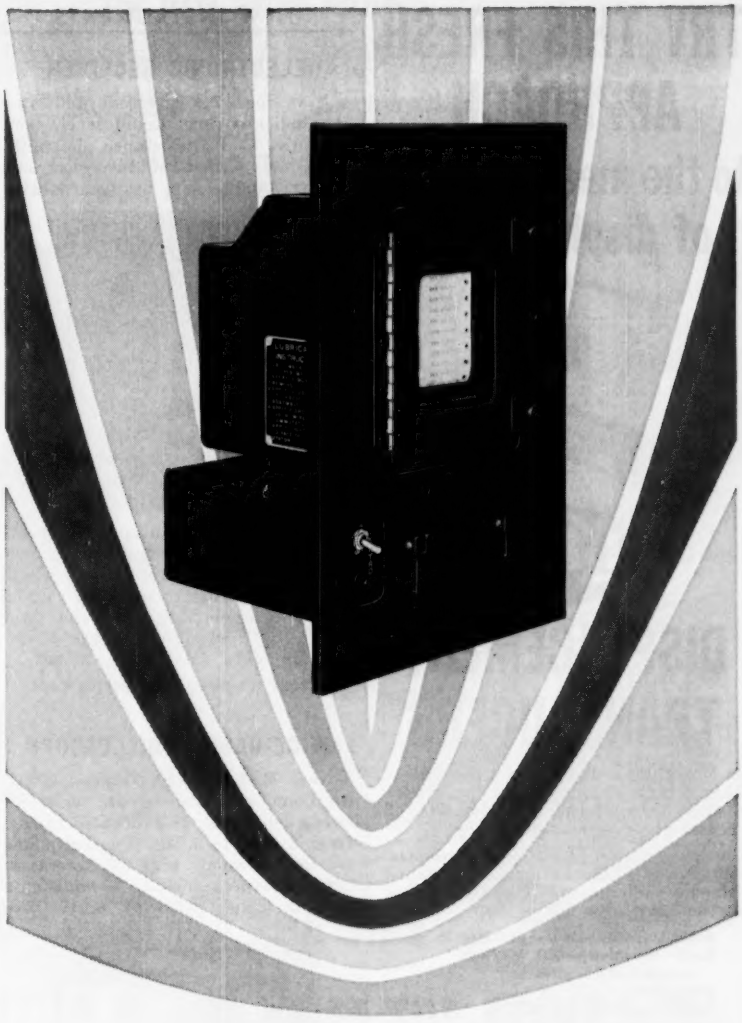
AUTOMATIC CHART CHANGER

New Automatic Meterman affords utilization of up to forty circular charts in a single recorder; it disengages the charts, one by one, at virtually any desired time/date frequency and drops them by gravity



into a self-contained storage box. Uses only a minute portion of available clock power. Can be used on all circular-chart recorders of any diameter on thickness.—8-page pocket folder gives details.—*Maeder-Squier Co., Box 5145, Dallas 22, Texas.*

CIRCLE 208 ON READER-SERVICE CARD



NEW CLARY MILITARIZED PRINTER

WITHSTANDS 50G SHOCK!

The new Model 2000 series printers designed by Clary will print digital data even under the extreme environmental conditions encountered in military use • These rugged, reliable printers are constructed on a sturdy panel for vertical rack mounting, and contain all necessary electronic equipment for data decoding, digit selection, and control functions of the printer • They are designed to print the output from computers, digital voltmeters, shaft position transducers, electronic counters and digital clocks. In addition, they are ideal in industrial applications where continuous, unfailing operation is required • For complete information on how Clary Model 2000 series can help you, write today for Engineering Bulletin S-120 •

Clary

Electronics Division

San Gabriel, California

CIRCLE 106 ON READER-SERVICE CARD

TRY THIS FRESH APPROACH

to the measurement of displacement

DISPLACEMENT TRANSDUCERS

No longer are weak outputs a problem in the application of displacement transducers to the measurement or indication of mechanical movements electrically.

You have a reliable source for displacement transducers—International Resistance Company—offering you a vastly superior precision product *at a lower cost.*

Better Linearity—as low as 0.1%
Better Sensitivity—2.0 MV/Volt Input/Mil at 60 cycles
Linear Range: .005" to 4.0"
Frequency: 50 to 20,000 CPS
Null Voltage: 0.25% of total output, or less
No moving parts to wear
Longer, Infinite Life
Resolution: Infinite
Precision assured by close control at every step in manufacture

Special designs available for:
- **High temperature (1200°F)**
- **Nuclear radiation resistance**
- **120V. inputs; up to 50V. outputs**
- **Zero temperature coefficient**
- **Matched units for complete interchangeability**

For complete information including many more advantages of IRC Displacement Transducers write for Bulletin R-3b.

Compu-trans

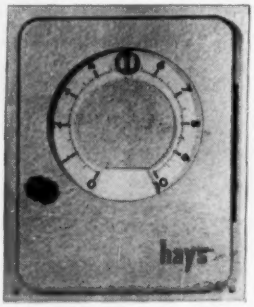
International Resistance Company
COMPUTER COMPONENTS DIVISION
Dept. 454, 401 N. Broad St., Philadelphia 8, Pa.
In Canada: International Resistance Co., Ltd. Toronto, Licensee.

CIRCLE 107 ON READER-SERVICE CARD

NEW INSTRUMENTS

ELECTRONIC RECEIVER

New Model 721 Electronic Indicator can indicate flow, liquid level, temperature, % O_2, resistance, d-c millivolts, etc. Either of two electronic receiver units can be incorporated

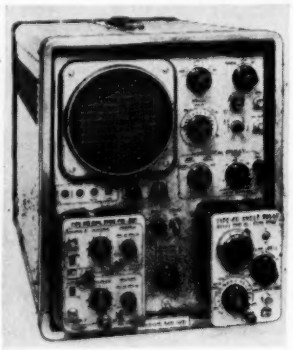


for operation with suitable transmitters—a differential transformer receiver, or a slidewire receiver. Features 4.4-sec pointer travel full scale, with 300-degree indication and total scale length of 12¾".—*Hays Corp., Michigan City, Ind.*

CIRCLE 167 ON READER-SERVICE CARD

WIDE-BAND OSCILLOSCOPE

New Model K-120 Single-Channel Oscilloscope features an accurate sweep delay with 18 calibrated ranges from 2 μsec to 1 sec per centimeter as an optional plug-in accessory. Other features include a wide-band vertical amplifier with 0.017 μsec



rise time, sweep lock-out, beam position indicators, single knob calibrator and sweep controls, and others that simplify operation and waveform analysis. Several plug-in pre-amplifiers are also available.—*Electronic Tube Corp.* 1200 *E. Mermaid Lane, Phila.* 18, *Pa.*

CIRCLE 168 ON READER-SERVICE CARD

THERMISTOR THERMOMETER

New thermistor-actuated Temperature Indicator, Model 116, is available in nine ranges covering −30 to 350°F. Sensing probes are inter-

TYPICAL EXAMPLE of a Fairchild Motion Analysis Package includes Motion Analysis Camera HS401 with high-speed HS504-B1 kit (speeds from 2100 to 8000 pps), light meter, power supply, timing light generator, camera and event synchronizer, special tripod, slave timer for rapid start-stop, and Mini-Rapid Processor.

ALL YOU NEED FOR PHOTOGRAPHIC MOTION ANALYSIS

— *in a single Fairchild package*

With a Fairchild integrated camera system, engineered to your requirements, you benefit these 4 ways:

1. Immediate answers to your problem. You can shoot and develop 100 feet of film in as little as 20 minutes.

2. Ease of operation. All units are compatible with each other. No other equipment is needed. Operation is simple and quickly learned.

3. Portability. Light-weight, compact construction permits you to carry the equipment anywhere — even store it in your car trunk — and set it up quickly.

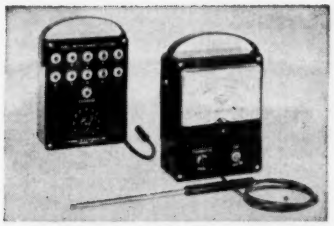
4. Service. An experienced Fairchild Sales Engineer will gladly help you determine the package most suitable for your needs, and help you with basic applications.

Write for booklet "Conserve Valuable Engineering Hours" to Industrial Products Division, Dept. 22, Fairchild Camera and Instrument Corp., 580 Midland Ave., Yonkers, N. Y.

INDUSTRIAL PRODUCTS DIVISION
FAIRCHILD
CAMERA AND INSTRUMENT
CORPORATION

Represented in the 11 Western States by Gordon Enterprises, 5362 N. Cahuenga Blvd., No. Hollywood, Calif.

CIRCLE 108 ON READER-SERVICE CARD

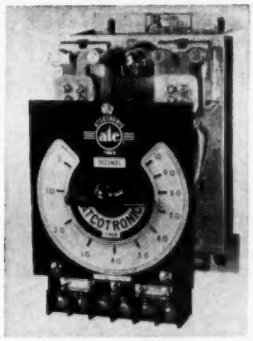


changeable and accurate to 0.5°F under 100°F, and 0.5% of reading over 100°F. Can be used with Model 119 Channel Selector for readout of ten temperature points.—*Fenwal Electronics, Inc., Mellen St., Framingham, Mass.*

CIRCLE 169 ON READER-SERVICE CARD

ELECTRONIC TIMER

New printed-circuit electronic Timer for short interval time control, Model 5231-B, features two heavy-contact, four-pole, double-throw re-

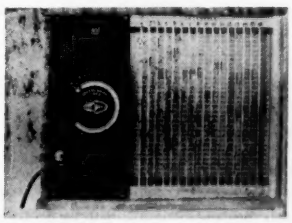


lays rated at 15 amp. Variety of timing ranges available, including 0.02 to 1 sec. 0.5 to 30 sec. etc. Maximum standard ranges available are 60 and 120 sec.—*Automatic Timing & Controls, Inc., King of Prussia, Penna.*

CIRCLE 170 ON READER-SERVICE CARD

TIMER

New Interchron Timer Model 52 controls from 1 to 16 intervals of up to 30 min in 10-sec increments; entire program can be repeated through use of a reset control switch. Accuracy is within 1% of the 30-min



maximum for each interval. At end of each interval a chime sounds for timing manual operations and an electrical contact closes momentarily to operate relays, switches, etc.—*Bald Eagle Corp., 356 Cedar St., St. Paul, 1, Minn.*

CIRCLE 171 ON READER-SERVICE CARD

The NEW Series BH100

MILLI-V-METER*

THE INSTRUMENT with the TAPE-SLIDEWIRE

1/10 THE SIZE...

10 TIMES THE ACCURACY OF STANDARD INSTRUMENTS!

- *Resolution: 1 part in 10,000*
- LABORATORY PRECISION for the operating plant.
- COMPATIBLE with any transducer—AC or DC.
- For strain gage, linear differential transformer, thermocouple, thermistor, resistance thermometer, pulse or variable frequency circuits or systems.
- Parabolic or logarithmic functions are linearized for direct digital reading.
- Every scale unit is a calibrated value.

Produced by the makers of the JETCAL® *jet engine Analyzer... in worldwide military and airline use!*

* TRADE MARK

Full information is available for the asking!

B & H INSTRUMENT CO., INC.

3479 West Vickery Blvd., Fort Worth 7, Texas

Sales-Engineering Offices:
ATLANTA, GA., COMPTON, CAL., DAYTON, OHIO, VALLEY STREAM, L.I., N.Y., WICHITA, KAN.
TORONTO, ONT. (George Kelk Ltd.), MITCHAM, SURREY, ENGLAND (Bryans Aeroquipment Ltd.)

CIRCLE 109 ON READER-SERVICE CARD

NEW

Small, Lightweight

MERCOID PRESSURE CONTROL

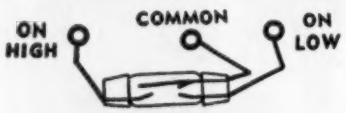
AP-153

WEIGHT: 1¾ lbs.

FOR MEDIUMS NOT INJURIOUS TO STEEL OR SILVER SOLDER

CIRCUIT

SP-DT HERMETICALLY SEALED MERCURY SWITCH (4A. 115V., 2A. 230V.)



Provides any of following operations:

1. *Single Pole—Cut-in high (close on rise)*
2. *Single Pole—Cut-in low (open on rise)*
3. *Single Pole—Double Throw*

OPERATING RANGE

ADJUSTABLE OPERATING RANGE	SWITCH DIFFERENTIAL PSIG. With Pointer Set At LOW	HIGH
1 to 20 psig.	0.3	0.5

CONSTRUCTION

ADJUSTMENT: External
PRESSURE ELEMENT: Fairprene diaphragm
PRESSURE CONNECTION: ¼" I.P.S.
MOUNTING: Has two mounting ears (one on each side of control) or control may be pipe mounted by means of the ¼" I.P.S. bottom connection.
INTERNAL WIRING CONNECTIONS: 3 post terminal block.
CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front) finished in charcoal-gray.

WRITE FOR BULLETIN 02

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

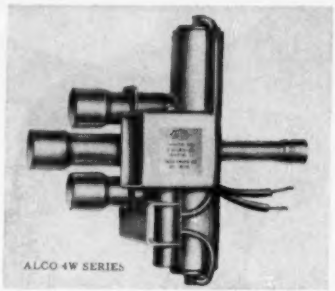
CIRCLE 110 ON READER-SERVICE CARD

STRAIN GAGE CEMENTS

New EPY-150 and EPY-400 Epoxy Cements, formulated for use with bonded-filament strain gages, have maximum service temperature of 150°F and 400°F respectively. Furnished in small plastic packs, each divided into two compartments containing the liquid adhesive and the activator, respectively. Cement is mixed for use simply by removing the split metal pin which divides the pack and kneading with the fingers. —*Baldwin-Lima-Hamilton Corp., Electronics & Instrumentation Div., 42 Fourth Ave., Waltham 54, Mass.*

CIRCLE 209 ON READER-SERVICE CARD

4-WAY REVERSING VALVE

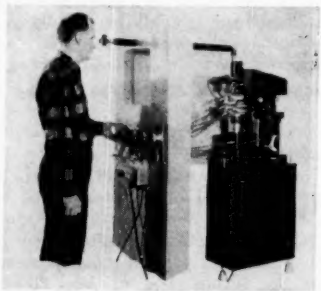


CIRCLE 210 ON READER-SERVICE CARD

New 4-way Valve in the 4W Series having a slide of cast iron and an outer shell of steel, needs no plastics for sealing or tight seating on account of fine machining and precision honing. Contains a carefully-balanced dashpot action to prevent mechanical hammering during shifting. Can be mounted in any position except with the pilot valve upside-down. Can be installed to shift to cooling or to heating on power failure for the "fail safe" position.—*Alco Valve Co., 865 Kingsland Ave., St. Louis 5, Mo.*

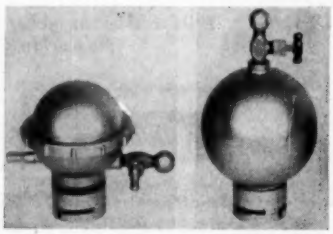
MICROHARDNESS TESTER

New Tukon Tester is designed for shallow-indentation hardness testing of "hot" metals or metal components that have been exposed to radioactive or nuclear-energy contamination. Features: remote-control automatic timing cycle of load application; vibration absorbing supports; vertical capacity of 5" without the Microton mechanical stage, 3½" with stage. Can accommodate test pieces up to 8" in height.—*Wilson Mechanical Instrument Div., American Chain & Cable Co., 929 Connecticut Ave., Bridgeport 2, Conn.*



CIRCLE 211 ON READER-SERVICE CARD

IONIZATION CHAMBER



CIRCLE 212 ON READER-SERVICE CARD

New spherical gas phase Ionization Chamber and a new Slide Chamber for solid and liquid samples eliminate "dead" space due to spherical design, so saturation is obtained at 90 volts or less for all ordinary currents. Slide chamber, 600 ml capacity, holds 2 sample planchets of 2¼" or smaller diameter.—*Applied Physics Corp., 2724 South Peck Rd., Monrovia, Calif.*

TIME CODE GENERATOR

New Model 1021 Generator consists of a crystal-controlled oscillator and seven decades of frequency division. Produces 8 separate timing signals—100,000 to 0.01 cps; each signal

coded by a different width. Mixed output range is 100 to 0.01 cps on a single channel.—*Computer-Measurements Co., 12970 Bradley Ave., Sylmar, Calif.*

CIRCLE 213 ON READER-SERVICE CARD

RECHARGEABLE SILVER-ZINC BATTERIES

New line of silver-zinc secondary (rechargeable) Batteries has high energy-to-weight ratios. Cells can be combined to develop power required. Cells range in size and output from Type SC-04 miniature cell of 0.5 amp-hour capicity (weight 0.05 pound) to Type SC-450, a single cell with a weight of 9.7 pounds and an output of 450 amp-hours. All cells are rated with a terminal voltage of 1.4 v under load.—*Cook Batteries, 3850 Olive St., Denver 7, Colo.*

CIRCLE 214 ON READER-SERVICE CARD

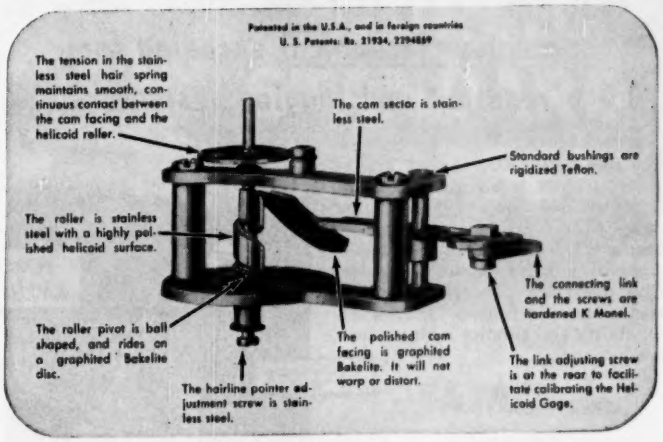
TRANSMITTING POTENTIOMETER

New Microsen Series E170 Transmitting Potentiometer, converting low-level d-c signals to proportional 1.0 to 5.0 ma d-c signals, is a semi-nullbalance, resistance-bridge design

with modular construction. Available with thermocouples or resistance bulbs for straight or differential temperature measurements. Also for millivoltage inputs as low as 0-10 mv, for current inputs as low as 0-10 μa and for service with strain gages and re-transmitting slidewires.—*Manning, Maxwell & Moore, Inc., 250 E. Main St., Stratford, Conn.*

CIRCLE 215 ON READER-SERVICE CARD

ACCO Helicoid Gage U.S.A.


Patented in the U.S.A., and in foreign countries
U. S. Patents: Re. 21934, 2294859
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides... *Sustained Accuracy... on the toughest jobs*

• Helicoid Gages have no gears, no teeth, reducing wear to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Helicoid Gages have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy, while conventional geared gages became useless after 500,000 cycles.

Helicoid Gages give *sustained* accuracy even when subjected to violent pressure pulsations or mechanical vibrations. Pointer can be set externally, without removing glass, and cannot be jarred out of position. Dial faces are easy to read, won't corrode or chip. A full range of Helicoid Gages is available for any application. Next time, specify Helicoid—the gage that *stays* accurate.

Bourdon Tubes won't Stretch, Leak, or Crack

Helicoid Bourdon tubes are made from seamless tubing, and are designed for maximum torque and minimum stress. At the factory, each tube is individually tested, overpressured, and stress relieved. Four materials—alloy steel, K Monel, stainless steel, and phosphor bronze—are available to meet applications ranging from tap water to almost any acid.

NEW! Solid-Front Safety Case Gives Added Protection

The new Helicoid solid-front case diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming, though not detaching, the back cover plate. Helicoid Gages are also available in phenol, acaloy flanged, acaloy flangeless, polished flangeless, round flush, polished flush ring, and square flush cases.

WRITE for details **Ask for Catalog DH-65**

HELICOID GAGES

ACCO

Helicoid Gage Division • American Chain & Cable Company, Inc.

929-B Connecticut Ave., Bridgeport 2, Conn.

CIRCLE 111 ON READER-SERVICE CARD

DIGITAL TRANSDUCER

provides mechanical encoding for read-out and logging systems

The new Series 400 Digital Transducer utilizes a standard sensing element (flow, pressure, or temperature) to actuate the mechanical American Force Amplifier which precisely positions a shaft encoder. The need for electronic accessories is eliminated. Increased reliability and simpler maintenance are assured.

SERIES 400

SPECIFICATIONS

Accuracy: 1% of span.
Repeatability: 0.5% of span.

WRITE FOR LITERATURE

AMERICAN METER COMPANY
INCORPORATED (ESTABLISHED 1904)

MECHANICAL COMPONENTS DEPARTMENT
BOX 309 • GARLAND, TEXAS

CIRCLE 112 ON READER-SERVICE CARD

SPECIAL KEYBOARDS

Any number of keys, bars, switches or lights in any arrangement you require—wired to your specifications.

Concord Keyboards can be found working with many different types of equipment throughout the United States and Canada. Only proven components with exceptionally long life characteristics are used. A typical example: a keyboard that has twelve keys and one bar, wired to a cable and connector with a steel case painted grey—$220. Delivery three to five weeks. Send us a sketch of your desired key layout and wiring specifications for an immediate estimate.

Also call upon us for your special requirements for paper tape or magnetic tape input equipment.

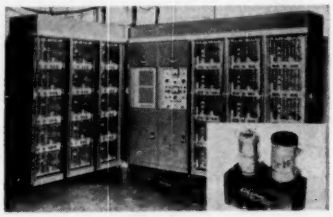
CONCORD CONTROL INC
1282 Soldiers Field Road, Boston, Mass.

CIRCLE 113 ON READER-SERVICE CARD

NEW INSTRUMENTS

ANALOG-DIGITAL LINK

New miniature Servo Package provides linkage between an analog and digital computer in new Addaverter

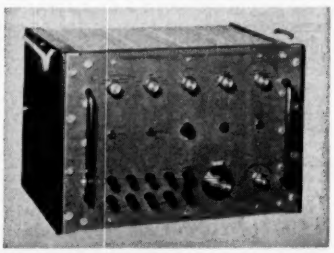


data conversion device. Comprises two gear clusters with a ratio of approximately 40:1 between the size 8 servo motor and the 1K potentiometer.—*Bowmar Instrument Corp., 8000 Bluffton Rd., Fort Wayne, Ind.*

CIRCLE 216 ON READER-SERVICE CARD

FUNCTION GENERATOR

New Function Generator, Model LF 51, designed by Servomex of England, generates over 37 different waveforms for testing servomechanisms, for vibration studies, medical research or geological problems; or

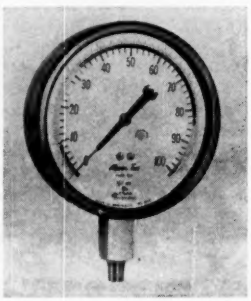


for programming automatic systems and analog computation. Instrument comprises 16 modules plus a fully-stabilized power supply. It will withstand 40 g's in any direction.—*Marconi Instruments, 111 Cedar Lane, Englewood, N. J.*

CIRCLE 217 ON READER-SERVICE CARD

PRESSURE GAGES

New Series 200 Master-Test line of Pressure Gages is individually deadweight tested and guaranteed accurate within ±¼% of the maximum dial reading over the entire range. Features include new "read-easy"



dial, "twin-tip" pointer, mirror dial (see illustration), or "non-parallax" dial. Available sizes are 4¼", 6" and 8".—*Marsh Instrument Co.*, 3501 *Howard St., Skokie, Ill.*

CIRCLE 218 ON READER-SERVICE CARD

POWER ISOLATOR

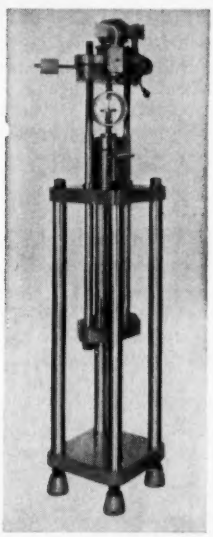
New portable Model 30 Power Isolator provides a 300-va (at 60 cps, 115 vac) output isolated from line voltage and line ground. Thus line-operated devices can be supplied with

ideal isolation without a common ground. Isolation insures flow of only mμamps of 60-cps line current from its output to line ground. The loading of the output to ground is less than 2μμf capacitance and greater than 50,000 megohms.—*Moeller Instrument Co., Electronics Div.*, 132*nd St. & 89th Ave., Richmond Hill* 18, *N. Y.*

CIRCLE 219 ON READER-SERVICE CARD

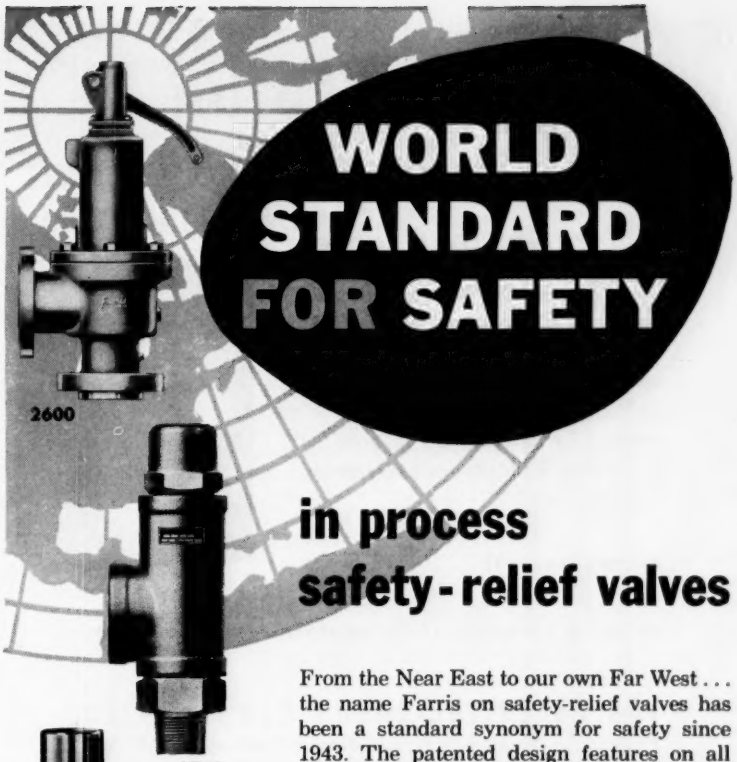
LOAD CELL CALIBRATOR

New Load Cell Calibrating Machine features new yoke to add mo-



torized or mechanical adjustment which speeds up calibration.—*Morehouse Machine Co.*, 1742 *Sixth Ave., York, Penna.*

CIRCLE 220 ON READER-SERVICE CARD



in process safety-relief valves

From the Near East to our own Far West . . . the name Farris on safety-relief valves has been a standard synonym for safety since 1943. The patented design features on all Farris full-nozzle valves combine to offer the ideal concept of a trouble-free, 100% safe safety-relief valve for every application.

SERIES 2600

The most popular top-guided, self-aligning, safety-relief valve for process piping service. Maximum pressure, 150 to 2500 psig, RF/RJ. Plain or Lever types. Standard or BalanSeal bellows construction.

SERIES 2740

A cast-steel relief valve of simplified design for use where extreme blow down accuracy is not essential, but where durability, compactness are. Pressures to 3500 psig at 450°F; 2000 psig at 800°F. Sizes ½" to 2".

SERIES 2745

An extremely rugged, compact, high pressure bar stock nozzle valve. Internal parts stainless steel. Adjustable blow down; flat seat; self-aligning stem and disc. Pressure to 10,000 psig. Sizes ½", ¾", 1".

SERIES 2950

A cast iron safety-relief valve including most of the exclusive Farris features found in the Series 2600. Max. pressure, 250 psig at 450°F, 400 psig at 150°F. Plain cap, open lever or packed lever types.

Complete information is provided in Catalog FE-118, covering both selection and sizing of Farris process Safety-Relief Valves. Send for your copy today.

PROGRESS THROUGH HONEST PURPOSE — Farris

ENGINEERING CORP.

706 Commercial Avenue, Palisades Park, N.J.

In Texas: 5405 Clinton Drive, Houston 20

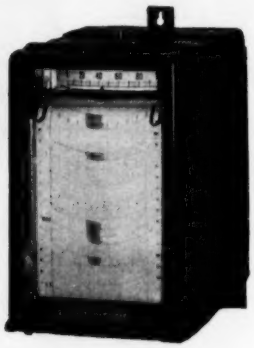
affiliates: FARRIS FLEXIBLE VALVE CORP. • FARRIS PICKERING GOVERNOR CO., INC. • FARRIS ENGINEERING, LTD., LONDON, ENGLAND

CIRCLE 114 ON READER-SERVICE CARD

BEST BY *DESIGN*

—Not by *Chance*

Constant attention to the wants and needs of users, has been worked into the finished recorder by trained designers, who devote their entire effort to producing the best in direct-writing recorders. *E-A Recorders are designed to be the best.* Performance has proved their superiority.



Ask for Catalog 657

PRODUCT REPRESENTATIVES IN MOST PRINCIPAL CITIES

The ESTERLINE-ANGUS Company, Inc.

Pioneers in the Manufacture of Graphic Instruments

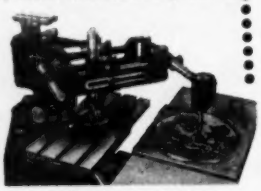
Dept. G, P. O. Box 596, INDIANAPOLIS 6, INDIANA

CIRCLE 115 ON READER-SERVICE CARD

how to get

faithful 3-dimensional reproduction

in steel, other metals and plastics



Use the LOW COST precision-built Preis Panto 3D-5 Engraving Machine. Does both 2 and 3 dimensional engraving effortlessly.

- Reversible spindle for enlarging or reducing from a model, die or sample
- Precision ball bearings throughout
- Reduction ratio range—1.6:1 to 7:1
- Four spindle speeds—7,000 to 18,000 RPM
- Micrometer adjustment collar
- Provided complete with floor stand and work tables

TRADE MARK PANTO

Write for complete details and prices. For immediate attention write directly to manufacturer below. Ask for nearest representative.

H. P. PREIS ENGRAVING MACHINE CO.

661 U. S. Highway 22, Hillside, N. J.

CIRCLE 116 ON READER-SERVICE CARD

Flow

Visualization

Instrumentation

Schlieren Systems

Shadowgraphs

Interferometers

Wind Tunnel Optics

Mountings & Piers

Packaged Systems

Catalog upon request

John Unertl Optical Co.

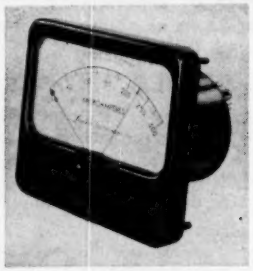
3551-3555 East Street

Pittsburgh 14, Penna.

CIRCLE 117 ON READER-SERVICE CARD

CONTACT METER CONTROLLER

New Model MR Transistorized Contact Meter Controller continuously indicates any electrical variable and

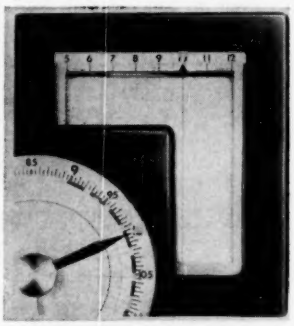


provides high or low limit control. Complete packaged plug-in units of contact meter, built-in transistor amplifier, power supply, and load relay. Accuracy of indicating is 2%, sensitivity 1 μw, repeatability is less than 1% of full scale.—*Larson Instrument Co., 24 Orchard St., Tarrytown, N. Y.*

CIRCLE 221 ON READER-SERVICE CARD

TEMPERATURE CONTROLLER

New Speedomax H Recording Controllers for steam temperature control are made in two models: Model S (strip chart) is for detailed records

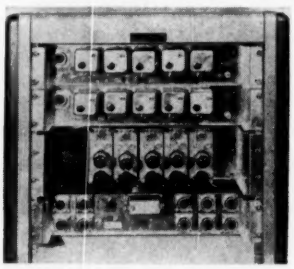


with its 6½" linear scale; Model R (round chart) is recommended for bold indication. Range is 500° to 1200°F; accuracy is better than ±0.3%; sensitivity better than ±0.1%.—*Leeds & Northrup Co., 4934 Stenton Ave., Phila., 44, Pa.*

CIRCLE 222 ON READER-SERVICE CARD

ITV SWITCHING SYSTEM

New AVS-X System, capable of switching signals from any number of TV cameras to any number of viewing monitors, uses plug-in modules throughout. A typical installation consists of one or more ADM-1

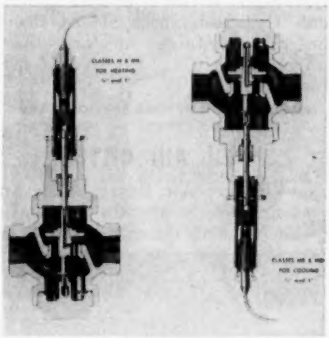


input modules, an ADA-1 Amplifier Rack with amplifiers, an ADH-1 Control Distribution Panel, and one or more ADS-6 Remote Video Switchers. An important feature is that the signal distribution plan is determined by a coded shorting plug.—*Kin Tel Div., Cohu Electronics, 5725 Kearny Villa Rd., San Diego 12, Calif.*

CIRCLE 223 ON READER-SERVICE CARD

TEMPERATURE REGULATOR

New self-actuated temperature regulators—Class M (direct acting) for heating service, and Class MR (reverse acting) for cooling service—

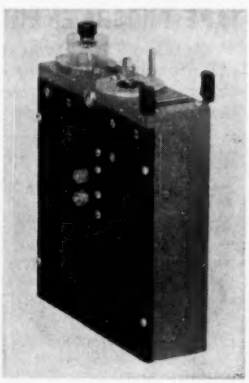


made in ¾" and 1" body sizes in both cast iron and bronze with screwed ends, feature a unique balancing bellows which permits smooth functioning at inlet pressures and pressure drops up to 100 psi; and a self-aligning, single-seated, tight-closing main valve which is guided throughout its entire stroke.—*Leslie Co., 122 Delafield Ave., Lyndhurst, N. J.*

CIRCLE 224 ON READER-SERVICE CARD

TRANSISTORIZED GALVANOMETER

New Model G3 Transistorized Galvanometer provides high current gains up to 1000 and voltage gains up to 15. Input impedance ranges



from 200 to 2300 ohms. Linearity is ±1.5% of full scale. Temperature stability is assured with silicon transistors.—*Photron Instrument Co., 6516 Detroit Ave., Cleveland 2, Ohio.*

CIRCLE 225 ON READER-SERVICE CARD

measure absolute and differential pressure accurately, easily with

W & T PRECISION MERCURIAL MANOMETER

For all types of precise pressure measurements in production, research, or analysis, the Wallace & Tiernan Type FA-135 Precision Mercurial Manometer gives readings with an accuracy of 1:3000.

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	✓	Detectors VPC • Hot Wire • Thermistor	✓	
	✓	T/C Cells—On Stream	✓	
✓	✓	Temperature Regulated Cells • Hot Wire —to 400° C • Thermistor—to 100° C	✓	✓
✓		GAS GRAND-MASTER—Portable T/C Analyzer • Amplified output for readout by RUSTRAK or ESTERLINE ANGUS recorders		✓
✓		Semiconductor Special Power Supply for T/C Cells and VPC Detection • Microdial zero control • Low noise for 0-1 mv recorder readout		✓

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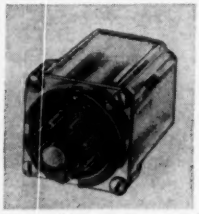
CIRCLE 122 ON READER-SERVICE CARD

D-C RELAY

New Series 5D1C d-c relay is a polystyrene-enclosed plug-in unit with 8-pin octal plug-in mounting.

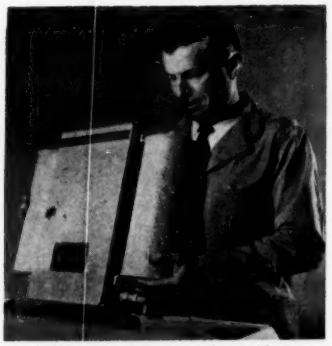


Easily removable case permits field adjustment without special equipment. Coil resistances of 500-13,000 ohms are maintained in stock.—*Kurman Electric Co.*, 191 *Newel St., Brooklyn* 22, *N. Y.*

CIRCLE 226 ON READER-SERVICE CARD

SMALL AIR DRYER

New Budget Air Dryer is for applications which require extremely dry air in small quantities, up to 20

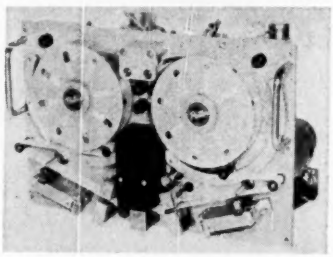


cu-ft/min. Cycle of adsorption and reactivation is automatic until shut down. Range is from 5 psig to 150 psig.—*Pittsburgh Lectrodryer Div., McGraw-Edison Co., P. O. Box* 1766, *Pittsburgh* 30, *Penna.*

CIRCLE 227 ON READER-SERVICE CARD

TAPE PROGRAMMER

New Perforated Tape Programmer, Model 3277, for use in military check-out systems, features bi-directional drive, character reading rates up to

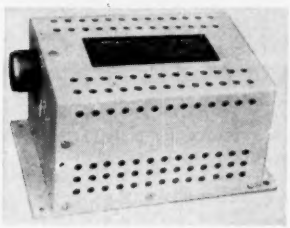


200/sec, tape widths up to 1", and self-contained electronics for control and data playback. Conforms to MIL-E-16400.—*Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, N. Y.*

CIRCLE 228 ON READER-SERVICE CARD

FREQUENCY CONVERTER

New series of Power Converters from variable frequency to constant frequency features ±0.01% frequency regulation, and 78% efficiency. In-

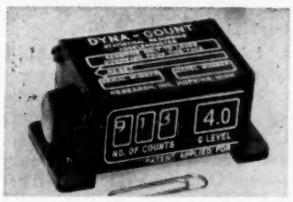


put-voltage range is from 95 to 135 vac, and input frequency range is from 360 cps to 980 cps. Models are available up to 3000 va.—*Power Supplies, Inc., Highland, Ill.*

CIRCLE 229 ON READER-SERVICE CARD

RECORDING ACCELEROMETER

New low-cost Dyna-Count, recording mechanical shocks perpendicular to its mounting surface, is completely self-contained and self-energized (like a self-winding wrist watch). Its digital counter has a range to 999. Typi-

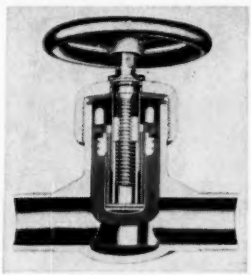


cal uses are in evaluation of the cushioning effect of protective packaging, in tests of vehicle springing or road bumpiness, and in structural strength analysis.—*Research, Inc., 115 North Buchanan, Hopkins, Minn.*

CIRCLE 230 ON READER-SERVICE CARD

PLASTIC VALVE

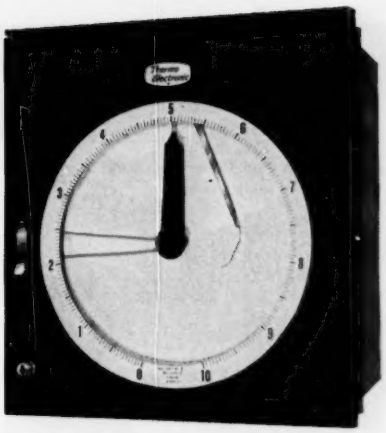
New all-plastic Hand Valve features tight sealing by a soft-rubber cup which is forced to the concave bottom of the passage, and straight-through design, with screwed,



flanged, or socket ends. The working pressure is 145 psig although all valves are tested at 230 psig. Available sizes are from 1" to 4".—*W. S. Rockwell Co., 200 Eliot St., Fairfield, Conn.*

CIRCLE 231 ON READER-SERVICE CARD

Versatility **makes the difference in the** *Thermo® Electronic* **Indicating Recorder**



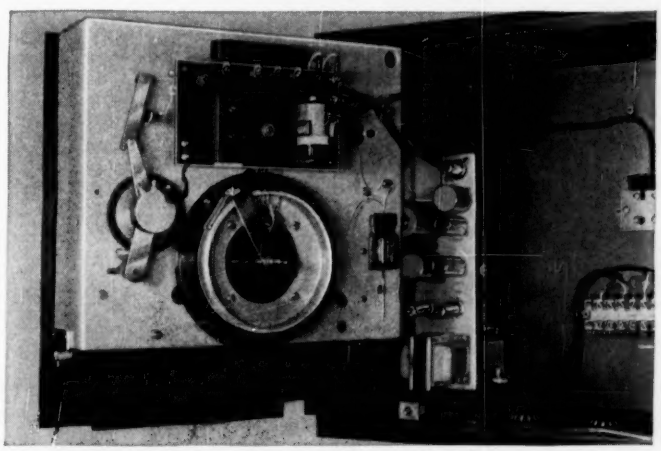
No matter what your application, you can rely on Thermo Electronic Recorders for unsurpassed accuracy, sensitivity and stability. Both potentiometer and bridge types are available. These instruments will automatically indicate and record any process variable (temperature, humidity, pH, conductivity, power, strain, etc.) that can be converted to a voltage or resistance change. Instrument accuracy is ± 0.25% of full scale, sensitivity is ± 0.125% and full scale pointer and pen travel is 5 seconds. The 34" scale and indicating pointer are clearly visible from a great distance.

In use, you get a continuous fine-line circular chart record of your process. Recording pen rarely needs refilling. Easily interchanged ranges permit recording of an almost unlimited variety of process variables.

The heart of the Indicating Recorder is the exclusive Thermo Electronic high-gain servo-amplifier, which couples exceptional stability (± 1 microvolt) with extreme sensitivity. It will maintain operating characteristics even under the most adverse conditions. This guarantees consistently accurate performance in recording your process functions. Full sensitivity of the amplifier is used in standardization. Two or three position controls, or up to six alarm contacts are optional. Built-in fail-safe action is standard.

Your recording requirements can best be met with Thermo Electronic Instruments.

Write today for Catalog 66-F



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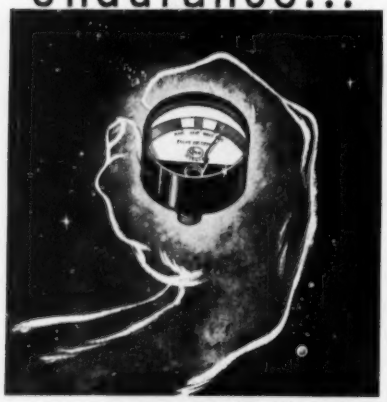
beyond normal endurance...



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CIRCLE 126 ON READER-SERVICE CARD

HIGH-TEMP CONNECTOR

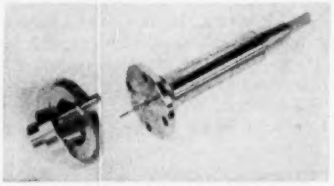
New line of Thermocouple Connectors with ceramic inserts withstands temperatures up to 1000°F and can

be used in power as well as thermocouple circuits. Presently available in five-, nine- and eleven-contact configurations for welded, soldered, or brazed connections for up to #14 wire.—*Harco Laboratories, Inc.*, 77 *Olive St., New Haven, Conn.*

CIRCLE 232 ON READER-SERVICE CARD

DISPLACEMENT TRANSDUCERS

New Models 580 and 581 Linear Displacement Transducers are primarily for use with Sanborn 150-, 350- and 850-Series carrier ampli-



fiers, or 150-, 350- and 850-Series phase sensitive demodulator amplifiers. Both models have a maximum stroke of ±0.050" (0.100" total); 0.5% linearity; and operate from 5-v, 2400-cps excitation.—*Sanborn Co., Industrial Div.*, 175 *Wyman St., Waltham* 54, *Mass.*

CIRCLE 233 ON READER-SERVICE CARD

HIGH-ACCURACY VOM

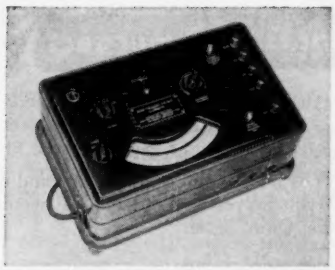
New Model 270 Volt-Ohm-Milliammeter features d-c accuracy of 1½% full scale at 77°F, a mirror

scale, ½% resistors, gold-bonded diodes, polarity switch, and knife-edge pointer.—Bulletin ST-301 A contains details.—*Simpson Electric Co.*, 5200 *West Kinzie St., Chicago* 44, *Ill.*

CIRCLE 234 ON READER-SERVICE CARD

R-F VOLTAGE CALIBRATOR

New Model RFVC Radio-Frequency Voltage Calibrator provides 4 true-rms voltage output ranges for VTVM calibrations between 2 mv and 3 v. Accuracy is 0.3% of full

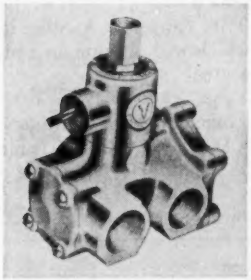


scale, and maximum frequency influence is ±0.2% from dc to 10 Mc.—2-page bulletin gives details.—*Sensitive Research Instrument Corp.*, 310 *Main St., New Rochelle, N. Y.*

CIRCLE 235 ON READER-SERVICE CARD

SOLENOID VALVES

New L3 Series of three-way Solenoid Valves for oil, air, water, vegetable and petroleum oils, inert gases, kerosene, gasoline, etc. are bubble-

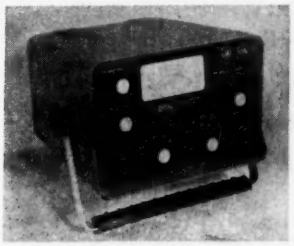


tight, compact, light, mount in any position directly to the line, and operate on a pressure differential of 5 to 150 psi. Available in ⅜", ½" and ¾" sizes.—*Skinner Electric Valve Div., Dept. LL69, 105 Edgewood Ave., New Britain, Conn.*

CIRCLE 236 ON READER-SERVICE CARD

WIDE-RANGE VOLTMETER

New series of R-2 Voltmeters measures a-c and d-c voltages from 1 mv to 1000 v full scale in 14 ranges,



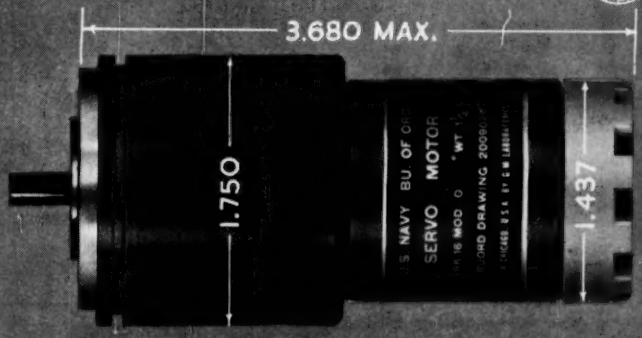
and midscale resistances from 10 ohms to 10 megohms in 7 decade ranges. Accuracy is better than 1% on dc; on ac better than 2%, from 20 cps to 100 kc; and 5%, from 10 cps to 1 Mc.—*Southwestern Industrial Electronics Co., Div. of Dresser Industries, Inc.*, 10201 *Westheimer Rd., P. O. Box* 13058, *Houston* 19, *Texas.*

CIRCLE 237 ON READER-SERVICE CARD

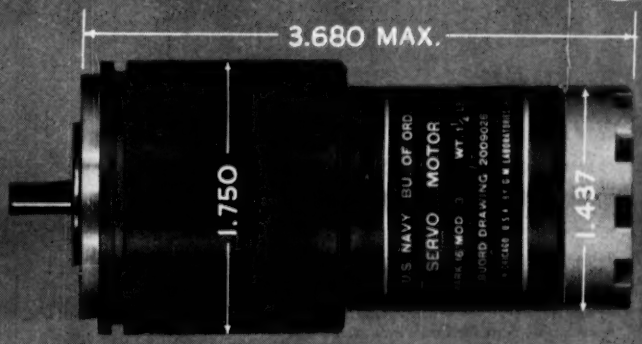
GM TACHOMETER-GENERATORS

Built to all applicable Government Specifications.
In production—available for prompt delivery.

BuOrd Mark 12 Mod 0 SERVO MOTOR Tachometer Generator 115 volts / phase, 4500 RPM (min).



BuOrd Mark 16 Mod 0 SERVO MOTOR Tachometer Generator 115 volts / phase, 4500 RPM (min).



BuOrd Mark 16 Mod 3 SERVO MOTOR Tachometer Generator for transistor operation 115 volts fixed phase 36/18 volts control phase, 4500 RPM (min.)

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G-M Servo Motors
manufactured by the Components Division of
G-M LABORATORIES INC.
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RIGID STEM
Something much finer in a dial thermometer: finer because it is the bourdon tube type of thermometer at its best...embodies the greater precision and lasting accuracy of the Marsh Pressure Gauge.
Both vapor tension and gas-filled types are available in either distant reading or rigid stem types. In the broad Marsh line you have a complete selection of temperature ranges, case sizes, styles, and finishes.
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Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co., (Canada) Ltd.
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Houston Branch Plant, 1121 Rothwell St.
Sect. 15, Houston, Texas

CIRCLE 128 ON READER-SERVICE CARD

new plants and mergers

DU PONT COMPANY is building new laboratory and office facilities for its Mylar polyester film technical section adjoining its Circleville, Ohio, plant.

AMERICAN MACHINE AND METALS has purchased the assets of Automatic Devices Co., of Western Springs, Ill. and will operate it as its Automatic Devices Div.

PENBERTHY MFG. CO. soon will move from Detroit to new facilities at Prophetstown, Ill., and will be designated as Prophetstown Mfg. Div. of Buffalo-Eclipse Corp.

CHEMPUMP recently moved into new, larger quarters at Huntingdon Valley, a suburb of Philadelphia, and will be operated as the Chempump Div. of the Fostoria Corp.

U. S. RADIUM has completed a new addition to the plant and substantially doubled its capacity. Another facility has also been taken over which will provide an additional 25,000 sq ft of production area.

TEXAS INSTRUMENTS is expanding the Kentucky Plant of its Metals and Controls Div. by 9,600 sq ft which will increase by one third the manufacturing space of the 28,000-sq-ft plant.

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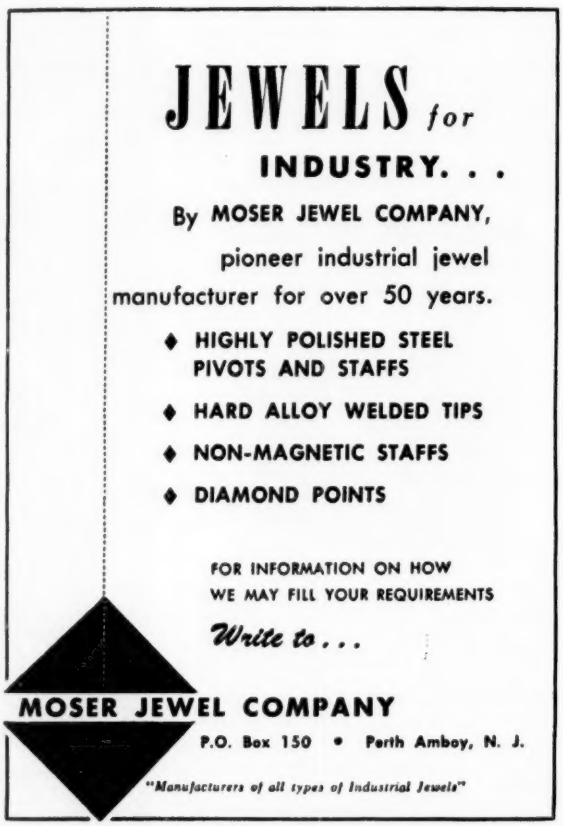
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CIRCLE 130 ON READER-SERVICE CARD

ITEMLAB, INC. and **ITEMCO, INC.**, its parent organization, have voted a merger pending approval by stockholders and SEC.

FOXBORO COMPANY and RADIO CORP. OF AMERICA jointly announced that they "are combining instrumentation, process control, and digital computer know-how to supply industry its first completely-integrated computing control system." Under the arrangement Foxboro will act as manufacturer's representative for RCA's industrial computer products and provide its own specialized instrumentation and process information.

people in the news

PACKARD BELL ELECTRONICS announces that *Russell J. LeVesque* has been appointed manager of the printed circuit department of the Technical Products Division.

DAYSTROM INSTRUMENT DIV. announces appointment of *Richard E. Bennett* as plant manager; *Leslie E. Daniels* as assistant sales manager; and *Edgar G. Grant* as engineering manager.

BAILEY METER CO. announces appointment of *K. R. Dodson* as resident engineer in Corpus Christi, Texas.

CHART-PAK announces appointment of *A. Philip Sherburne* as general sales manager.

DUMONT LABS. announces appointment of *Robert W. Deichert* as engineering manager for Scientific Instruments of the Industrial Electronics Div.

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for Recording Instruments

We offer to the Instrument Maker Charts for all methods of Recording: Pen, Ball Point, Electrical, Thermal, Pressure and Metallic Stylus.

Uniform accuracy is assured through the use of specialized equipment operated under controlled atmospheric humidity conditions.

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CHARTS INCORPORATED
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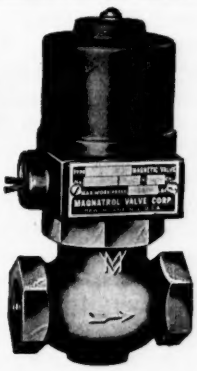
Eliminate
Costly
Flow Failures



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These three design advantages are your assurance against costly flow failures. Attain dependable, accurate, automatic or remote control of liquids or gases with **Magnatrol Valves.** Installed quickly and easily in connection with . . . flow-meters, thermostats, float and time switches. **Every Magnatrol Valve** is delivered to you—factory tested—guaranteed free from defects in material and workmanship.

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Catalog containing complete specifications mailed upon request.

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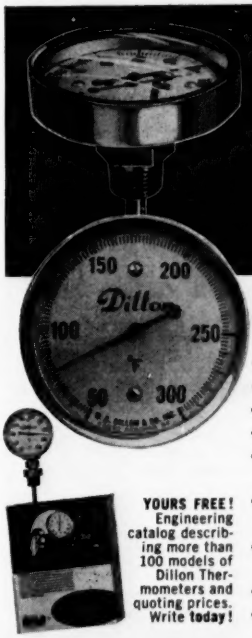

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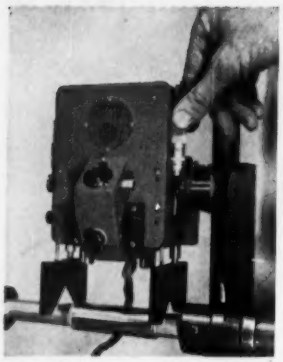

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You can measure torque without attaching slip rings, without cutting into the shaft, yet obtain accuracies of better than ½% full-scale with long term stability with a PhotoStress Torquemeter Transducer. The Transducer measures torque optically, eliminating contact between Transducer and shaft; result—there is no limitation to shaft speed. Nor is there any limitation to shaft size (except for shafts as thin as fine wire). Readout is digital or in millivolts—depending on the recording method desired.

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Send for Dewpointer bulletin. Tear out this ad and send on your letterhead to: Illinois Testing Laboratories, Inc., Room 518, 420 N. LaSalle St., Chicago 10, Ill.

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CIRCLE 134 ON READER-SERVICE CARD

PEOPLE—CONTINUED

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Clevite

W. G. HOLZBOCK
Sanders

F. M. JENNER
Consolidated Vacuum

L. M. FAULKNER
Hagan

BURNDY CORP. has elected *Marvin Lee* president. He succeeds *Bern Dibner,* who was elected chairman of the board of directors.

ELECTRIC SPECIALTY CO. announces appointment of *William E. H. Reardon* as vice president and sales manager.

PACIFIC ELECTRONIC CONTROLS CORP., a wholly-owned subsidiary of Royal Industries, Inc., has named *Donald C. Duncan* president.

STROMBERG-CARLSON announces appointment of *Warren C. Dunn* as manager of marketing for Stromberg-Carlson, San Diego.

CLEVITE CORP. announces promotions for two top executives: *Curtis B. Hoffman,* general manager of Brush Instruments Div., has been elected Clevite's vice president-electronics, and *John H. Harris,* who was general manager of the Texas Div. has been named general manager of Brush Instrument.

SANDERS ASSOCIATES, INC. announce that *Werner G. Holzbock* has been appointed assistant manager of the Instrumentation and Control Systems Laboratory.

CONSOLIDATED ELECTRODYNAMICS CORP'S., Rochester Div., recently started operations as **CONSOLIDATED VACUUM CORP.**, a wholly owned subsidiary of CEC, with *Frank M. Jenner* as new president.

HAGAN CHEMICALS & CONTROLS, INC., announces that *L. M. Faulkner* has been named manager of sales—data processing, Controls Div. He will be responsible for the sales of Kybernetes data systems, computing, and temperature monitoring equipments.

INTERNATIONAL RESISTANCE CO. announces appointment of *Walter Ware Slocum* as president of the company.

CONTINENTAL SENSING, INC. announces appointment of *B. C. Davis* as vice president.

TATNALL MEASURING CO. has formed a new management team: *Dr. John H. Buck* has been appointed vice president and general manager; Frank Tatnall, founder of the company, is now vice president in charge of sales development; and three product managers have been named: *James E. Starr* for MetalFilm strain gages and transducers; *Dr. Felix Zandman* for Photostress, the new photoelastic stress analysis technique; and *Edward S. Bowkley* for Tatnall and Krouse testing machines.

NORTH SHORE NAMEPLATE's president *Eugene T. Turney, Jr.* was among eleven men who recently were honored by Free Enterprise Awards Association's American Success Story Awards for their achievements.

E. T. TURNEY, JR.
North Shore

R. L. YEAGER
Electronic Assoc.

ELECTRONIC ASSOCIATES, INC., has named *Robert L. Yeager* as general manager, standard products (analog computers, standard instruments and data processing equipments). Mr. Yeager is also Chairman of the Eastern Simulation Council.

SAMA announces that *Horace M. Byrnes* has been appointed executive secretary of the Recorder-Controller Section.

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COPPER
*CORNING 707
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GALLIUM ANTIMONIDE
GALLIUM ARSENIDE
GARNET
GERMANIUM
GOLD
INDIUM ANTIMONITE
INDIUM PHOSPHIDE
INDOX
IRON SINGLE CRYSTAL
LITHIUM FERRITE
MAGNETIC PLUMBITE
MELAMINE FIBER GLASS
MICA, SYNTHETIC
NICKEL OXIDE
PLATINUM
POTASSIUM BROMIDE
*PYREX
*QUARTZ, CRYSTAL
*QUARTZ, FUSED
**SAPPHIRE
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ALL TYPES KNOWN GLASS

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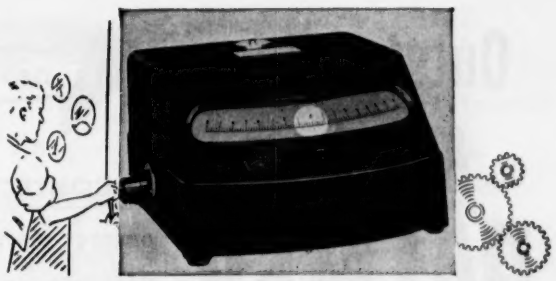
CIRCLE 135 ON READER-SERVICE CARD



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Laboratory Accuracy . . . Shop Ruggedness

The Cambridge Spot Galvanometer provides a complete outfit—galvanometer, lamp and scale—in one self-contained plastic case. It is robust, has a stable zero and does not require accurate levelling. The sharply defined spot can easily be read at a distance. The lamp may be operated on A.C. service current or 4-volt battery. Sensitivity in mm. on scale is from 19, 30 and 170 per micro-ampere using coils of 20, 50 and 400 ohms respectively. Scale can be read to 0.2 mm. Send for Bulletin 271.

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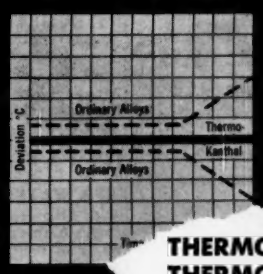

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Check these functional features

- Direct-drive Bourdon Coil with a filled system for longer lasting accuracy.
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- External calibration for zero setting.
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CIRCLE 138 ON READER-SERVICE CARD

new literature

CONTROL SYSTEMS

CONTROL SYSTEMS. 4-page Bulletin describes systems for full-scale automatic control in plants, refineries and pipelines.—Consolidated Systems Corp., a subs. of Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

CIRCLE 238 ON READER-SERVICE CARD

CYCLE CONTROLLER. 12-page Bulletin C311 contains features, specs, dimensions, and functioning of Model CIC500 cycle controller for batch process operations.—Bristol Company, Waterbury 20, Conn.

CIRCLE 239 ON READER-SERVICE CARD

PRODUCTION CONTROL. 6-page Brochure H-201 graphically explains operation of Telecontrol for supervision and production activities from a central location.—Telecontrol Div., Hancock Industries, Inc., Jackson, Mich.

CIRCLE 240 ON READER-SERVICE CARD

RECORDERS AND CONTROLLERS. 4-page Bulletin No. 66 describes and gives applications for electronic indicating recorders and indicatng recorder-controllers.—Thermo Electric Co., Inc., Saddle Brook, N. J.

CIRCLE 241 ON READER-SERVICE CARD

INSTRUMENTATION AND CONTROL. 8-page condensed catalog lists Hays instruments for pressure, flow, temperature, level, and gas analysis; receivers; and the all-electric combustion control systems.—Hays Corp., Michigan City, Ind.

CIRCLE 242 ON READER-SERVICE CARD

FEED WATER CONTROL. 4-page Bulletin 531 describes two-element and single-element air-operated feed water control systems.—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

CIRCLE 243 ON READER-SERVICE CARD

PRESSURE, VACUUM WEIGHT, ACCELERATION

MULTI-POINTER INDICATOR. 4-page Product Specification P11-1 illustrates and describes Mini-Line multi-point indicators for pressure, vacuum, temperature, etc.—Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

CIRCLE 244 ON READER-SERVICE CARD

VACUUM EQUIPMENT. 16-page product summary and price list classifies vacuum equipment and components by type and code number.—NRC Equipment Corp., 160 Charlemont St., Newton 61, Mass.

CIRCLE 245 ON READER-SERVICE CARD

PRESSURE PICKUP. 2-page Bulletin 1620 describes Type 4-326 pressure pickup capable of absolute and gage measurement to 10,000 psi.—Consolidated Electrodynamics Corp, 360 Sierra Madre Villa, Pasadena, Calif.

CIRCLE 246 ON READER-SERVICE CARD

WEIGHING SYSTEMS. Series of four 4-page fact folders containing basic information form a convenient means of collecting information on industrial weighing systems.—A. H. Emery Co., New Canaan, Conn.

CIRCLE 247 ON READER-SERVICE CARD

VACUUM TECHNOLOGY. 4-page issue of "Duo-Seal Digest," Vol. 2/No. 1 contains digests of 8 magazine articles (including ICS) pertaining to vacuum technology.—W. M. Welch Mfg. Co., 1515 Sedgwick St., Chicago 10, Ill.

CIRCLE 248 ON READER-SERVICE CARD

PRESSURE SCANNER. 2-page Bulletin 110 contains description; mechanical, electrical, and pressure details; and specs of Model SP-105 pressure scanner.—Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.

CIRCLE 249 ON READER-SERVICE CARD

BAGGING SCALE. 6-page Bulletin 0156A describes the GA-38 automatic bagging scale for high-speed loading of 25, 50 and 100-pound bags in feed mills.—Richardson Scale Co., Clifton, N. J.

CIRCLE 250 ON READER-SERVICE CARD

ENGINE PERFORMANCE METER. 2-page Bulletin K15A describes the Korfund Pi-Meter, a direct-reading performance meter for diesel, gasoline, natural gas, and steam engines. —Korfund Co., Inc., 48-355 32nd Pl., Long Island City, 1, N. Y.

CIRCLE 251 ON READER-SERVICE CARD

DISTILLATION EQUIPMENT. 16-page Bulletin 3-1 explains high-vacuum distillation and the equipment used such as pot stills, molecular stills and centrifugal molecular stills.—Consolidated Electrodynamics Corp., Rochester Div., 1775 Mount Read Blvd., Rochester 3, N. Y.

CIRCLE 252 ON READER-SERVICE CARD

ACCELEROMETERS. Three 2-page bulletins contain features and specs of the Models 50X2, 300 and 301, and 402 and 403.—Columbia Research Labs., McDade Blvd. and Bullens Lane, Woodlyn, Penna.

CIRCLE 253 ON READER-SERVICE CARD

FLOW, PUMPS, TEMPERATURE

TURBO-METER. 12-page Bulletin OG-417 describes the Turbo-Meter a high-capacity meter for use in petroleum pipelines.—Rockwell Mfg. Co., Meter and Valve Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

CIRCLE 254 ON READER-SERVICE CARD

PROPORTIONING PUMP. 2-page bulletin 1107-20-1 describes plunger-type, small-capacity proportioning pump for chemicals used in treating of small low-pressure boilers.—B-I-F Industries, Inc., 345 Harris Ave., Providence, R. I.

CIRCLE 255 ON READER-SERVICE CARD

POSITIVE-DISPLACEMENT METERS. 20 page Bulletin 43 describes Niagara

Industrial Liquid Meters.—Buffalo Meter Co., Inc., 2929 Main St., Buffalo 14, N. Y.

CIRCLE 256 ON READER-SERVICE CARD

ELECTRONIC FLOW MEASURING SYSTEMS. 4-page Bulletin 1388 describes automatic channel selecting flow measurement system for range ratios up to 1:1000.—Cox Instruments Div., George L. Nankervis Co., 15300 Fullerton, Detroit 27, Mich.

CIRCLE 257 ON READER-SERVICE CARD

THERMOCOUPLES. 52-page Catalog EN-S2 offers complete information about L&N's full line of thermocouples, thermocouple components, and accessories.—Leeds & Northrup Co., 4934 Stenton Ave., Phila. 44, Penna.

CIRCLE 258 ON READER-SERVICE CARD

ENVIRONMENTAL EQUIPMENT. 6-page folder illustrates and specifies environmental chambers and manufacturing facilities.—Itemco, Inc., 18 Beechwood Ave., Port Washington, N. Y.

CIRCLE 259 ON READER-SERVICE CARD

VALVES

VALVE POSITIONERS. 4-page bulletin illustrates and highlights FultroMatic pneumatic controller-positioner-valve, FultroLectric electric positioner, and FultroPilot pressure and temperature pilot controller.—Robertshaw-Fulton Controls Co., Fulton Sylphon Div., Knoxville 1, Tenn.

CIRCLE 260 ON READER-SERVICE CARD

CONTROL VALVE. 2-page catalog sheet describes the model 235-1 adjustable-cam, lever-operated control valve.—Atlas Valve Co., 280 South St., Newark, N. J.

CIRCLE 261 ON READER-SERVICE CARD

TIME, COUNT

GEARED COUNTER. 4-page data sheet and application guide describes operation, uses and modification available on a new line of high-speed, quick-reset geared counters.—Veeder-Root Inc., Hartford 2, Conn.

CIRCLE 262 ON READER-SERVICE CARD

COUNTING UNITS. 4-page bulletin contains construction data, operating instructions, electrical data, sketches, and illustrations of Sodeco single-decade counting units, Type 1TD.—Landis & Gyr, Inc., 45 W. 45th St., New York 36, N. Y.

CIRCLE 263 ON READER-SERVICE CARD

TIME RELAY. 4-page Bulletin SR-10 describes and tabulates specs of Dial Head Agastat time relays.—AGA Div., Elastic Stop Nut Corp. of America, Elizabeth, N. J.

CIRCLE 264 ON READER-SERVICE CARD

ELAPSED TIME INDICATOR. 2-page Bulletin 5001 describes the physical and electrical characteristics of the WT-1 subminiature elapsed time indicator.—Waltham Precision Instrument Co., 221 Crescent St., Waltham 54, Mass.

CIRCLE 265 ON READER-SERVICE CARD

INSTRUMENT COUNTERS. Two 2-page catalogs illustrate and describe 2 new lines of precision instrument counters.—Chicago Dynamic Industries, Inc., Precision Products Div., 1725 Diversey Blvd., Chicago 14, Ill.

CIRCLE 266 ON READER-SERVICE CARD

searchlite section

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• New Self-Flare fittings eliminate disadvantages of both flare and no-flare fittings. No costly preparatory operations . . . won't leak . . . can't be over tightened. For steel, stainless, copper, aluminum and plastic tubing.

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CIRCLE 139 ON READER-SERVICE CARD

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CIRCLE 145 ON READER-SERVICE CARD

HIGH-INTENSITY STROBOSCOPE. 4-page Bulletin 780 gives specs, description, and uses of Model 510-A1 high-intensity stroboscope for speeds from 60 rpm up to 15,000 rpm, manufactured by Electronic Brazing Co., Montclair, N. J.—Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.

CIRCLE 267 ON READER-SERVICE CARD

AIR

AIR DRYER. 4-page bulletin describes completely automatic Budget Air Dryer.—Pittsburgh Lectrodryer Div., McGraw-Edison Co., P. O. Box 1766, Pittsburgh 30, Pa.

CIRCLE 268 ON READER-SERVICE CARD

COMPRESSED AIR DATA. 16-page Form 1548 contains fundamentals on compressed air; and descriptions, terminology, and pointers on selection of air compressors.—Ingersoll-Rand 11 Broadway, New York 4, N. Y.

CIRCLE 269 ON READER-SERVICE CARD

DATA HANDLING

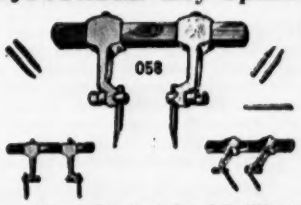
MAGNETIC TAPE PRODUCTS. Five 2-page bulletins (1592 thru 1595, and 1957) in folder describe complete line of miniature, lightweight amplifiers and power supply for magnetic tape recording.—Data Tape Div., Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

CIRCLE 270 ON READER-SERVICE CARD

DATA TRANSLATORS. 8-page quick-reference catalog defines the term "record reader" and discusses maker's

Eliminate makeshift or expensive special jigs with the . . .

ROLYN
ADJUSTABLE Key Spanner



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For Precise and Rapid Measurements of
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CIRCLE 143 ON READER-SERVICE CARD

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Immediate Shipment of Rebuilt Pyrometer Equipment From Stock
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17121 Greeley, Detroit 3, Mich.

CIRCLE 144 ON READER-SERVICE CARD

NEW LITERATURE

various types of record readers.—Benson-Lehner Corp., 11930 West Olympic Blvd., Los Angeles 64, Calif.

CIRCLE 271 ON READER-SERVICE CARD

MEMORY CORE TESTER. 4-page Bulletin 59-A describes the React automatic core tester, a high-speed magnetic memory core analyzer, and emphasizes the modular test system design approach.—Rese Engineering, Inc., 731 Arch St., Phila. 6, Pa.

CIRCLE 272 ON READER-SERVICE CARD

AN/DIG RECORDER. 8-page Catalog 35-1541 describes shaft-input device that converts and records analog values in digital binary-decimal punched tape form.—Fischer & Porter Co., 151 Jacksonville Rd., Hatboro, Penna.

CIRCLE 273 ON READER-SERVICE CARD

DIGITAL PRINTERS. 8-page Bulletin 671-71-3 discusses applications, features, and specifications of solenoid-actuated digital printers.—Victor Adding Machine Co., 3900 N. Rockwell St., Chicago 18, Ill.

CIRCLE 274 ON READER-SERVICE CARD

GAGING, TESTING

TEST EQUIPMENT FOR SERVOS. 25-page manual is a comprehensive report on the latest techniques of control synchro and control resolver testing.—Theta Instrument Corp., 48 Pine St., East Paterson, N. J.

CIRCLE 275 ON READER-SERVICE CARD

MICROMETERS. 4-page brochure covers precision motorized and manually-operated dead weight micrometers for measurement of paper, film, foil, and rubber sheet materials.—Testing Machines, Inc., 72 Jericho Turnpike, Mineola, N. Y.

CIRCLE 276 ON READER-SERVICE CARD

THE INTERNATIONAL INCH. 8-page booklet discusses problems a manufacturer can be expected to encounter as a result of America's change-over to the International Inch as of July 1, 1959.—Pratt & Whitney Co., Inc., Charter Oak Blvd., West Hartford 1, Conn.

CIRCLE 277 ON READER-SERVICE CARD

ELECTRICAL, ELECTRONIC INSTRUMENTS

PULSE HEIGHT ANALYZER. 4-page Form 3021-9 describes the Model PHA-120, a 100-channel pulse height analyzer with 20 channel storage.—Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

CIRCLE 278 ON READER-SERVICE CARD

MULTIPLIER-DIVIDER. 2-page leaflet contains general specifications, and some application notes on the multiplier-divider, Model K5-M.—George A. Philbrick Researches, Inc., 285 Columbus Ave., Boston 16, Mass.

CIRCLE 279 ON READER-SERVICE CARD

METER RELAY. 4-page Bulletin S-2, describes a new continuous reading meter-relay (CRMR).—Assembly Products, Inc., Chesterland, Ohio.

CIRCLE 280 ON READER-SERVICE CARD

PRINTING DEMAND METERS. 8-page Bulletin GEA-6892 describes maker's redesigned printing demand meters for recording of loads.—General Electric Co., Schenectady 5, N. Y.

CIRCLE 281 ON READER-SERVICE CARD

ELECTRONIC VOLTMETER. Brochure BK2409 contains information on electronic voltmeter which measures either true rms, peak, or average values of voltage over the frequency range from 2 to 200,000 cps.—B & K Instruments, Inc., 3044 West 106th St., Cleveland 11, Ohio.

CIRCLE 282 ON READER-SERVICE CARD

STATISTICAL EVALUATION OF METER ACCURACY. 8-page Bulletin GEA-5585A provides a method of obtaining logical and useful conclusions from studies of watt hour meter accuracy data.—General Electric Co., Schenectady 5, N. Y.

CIRCLE 283 ON READER-SERVICE CARD

INFRARED DATA. Folder contains three 2-page bulletins on bias supply, black body with temperature controller, and detector test console, respectively.—Infrared Standards Lab., 10555 Magnolia Ave., Riverside, Calif.

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RMS VOLTMETER. 2-page Bulletin 55 and 4-page Bulletin 42 contain specs and technical data, respectively, of random signal meter Model TBM-2.—Flow Corp., 85 Mystic St., Arlington, Mass.

CIRCLE 285 ON READER-SERVICE CARD

DIFFERENTIAL AMPLIFIER. Wall-size folder contains illustrations and highlights of wide-band, low-level differential d-c amplifier Model DA-102.—Epsco, Inc., Instruments and Equipment Div., 275 Massachusetts Ave., Cambridge, Mass.

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VECTORLYZER. 2-page bulletin contains description and specs of new instrument, Type 202, for measuring vector relations of alternating voltages.—Ad-Yu Electronics Lab., Inc., 249 Terhune Ave., Passaic, N. J.

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ELECTRIC MACHINERY. 4-page Form DC459 describes custom-designed systems approach to power converting systems and complete line of d-c generators.—Kato Engineering Co., Mankato, Minn.

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MISCELLANEOUS

DRAIN OR SAMPLING VALVES. 2-page Catalog 355, gives details of Jerguson No. 23 drain or sampling valve.—Jerguson Gage & Valve Co., 80 Adams St., Burlington, Mass.

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MINIATURE SWITCHES. 2-page Bulletin L-52S illustrates and describes two new switches: a printed-circuit switch, and a dual concentric-shaft switch.—Shallcross Mfg. Co., Preston St., Selma, N. C.

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CHROMATOGRAM SCANNER. 2-page Bulletin 160 describes Scanogram II, an automatic windowless chromatogram scanner for counting Tritium, Carbon-14, and Sulfur-35.—Atomic Accessories, Inc., 244-02 Jamaica Ave., Bellerose 26, N. Y.

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EQUIPMENT CONTROL CONNECTORS. 12-page Bulletin 372 gives complete information on equipment control connectors.—Joy Mfg. Co., Electrical Products Div., 1201 Macklind Ave., St. Louis 10, Mo.

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SEMICONDUCTOR RELAYS. 2-page Engineering Bulletin 65, describes semiconductor relays for high-speed signalling or data current control.—Rixon Electronics Inc., 2414 Reedie Dr., Silver Spring, Md.

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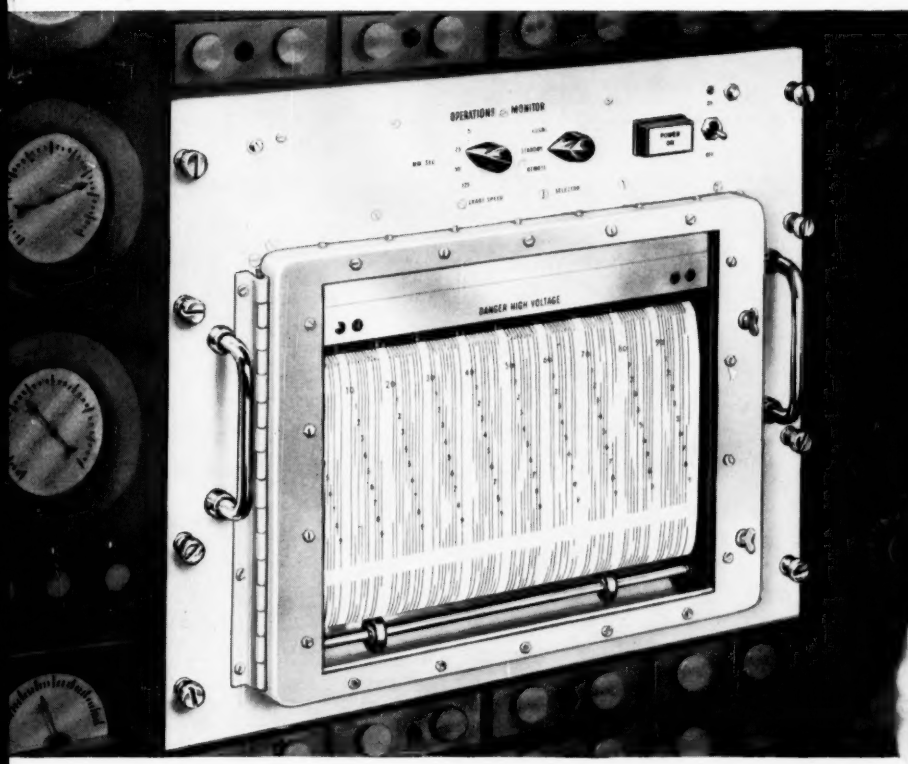

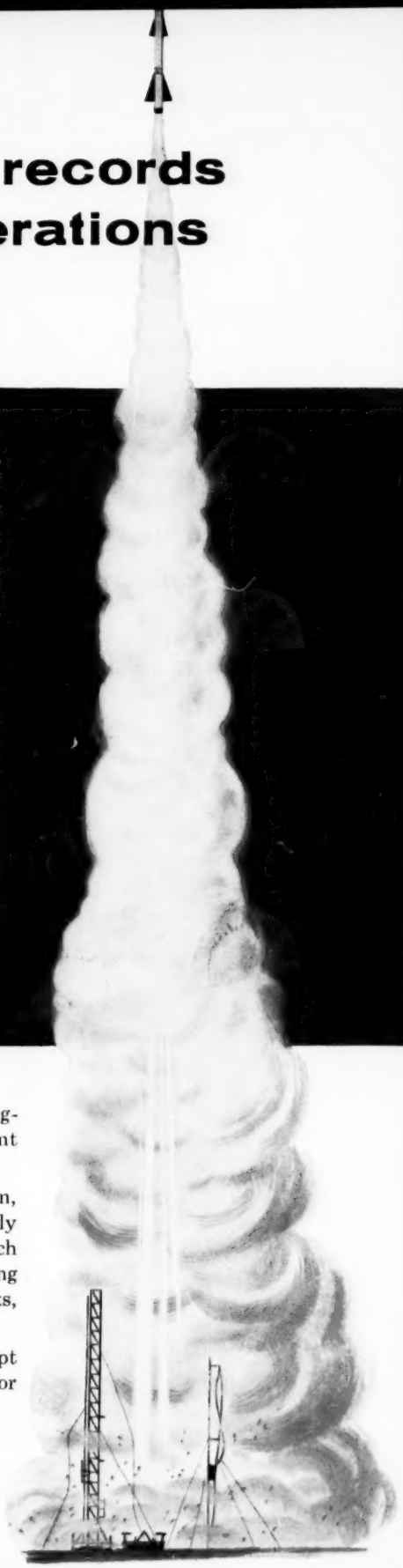

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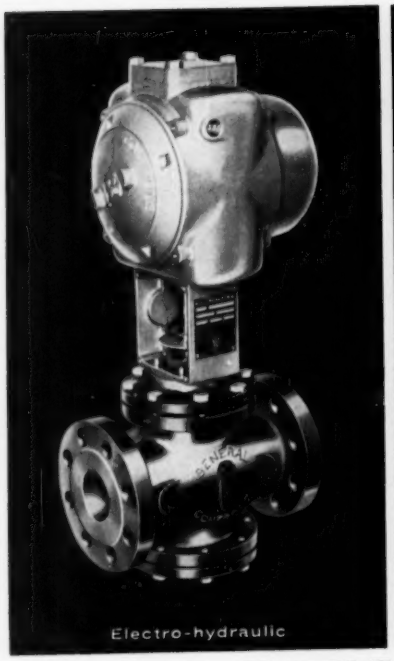

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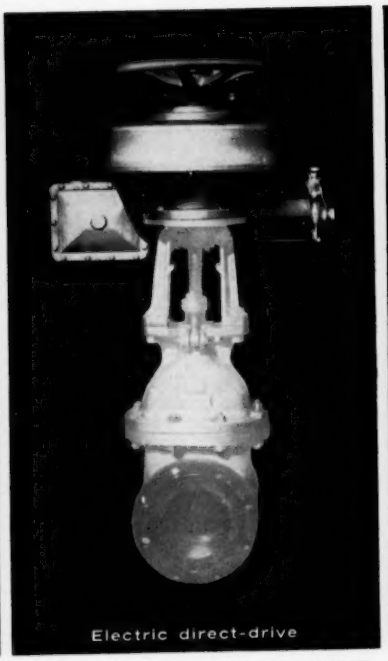

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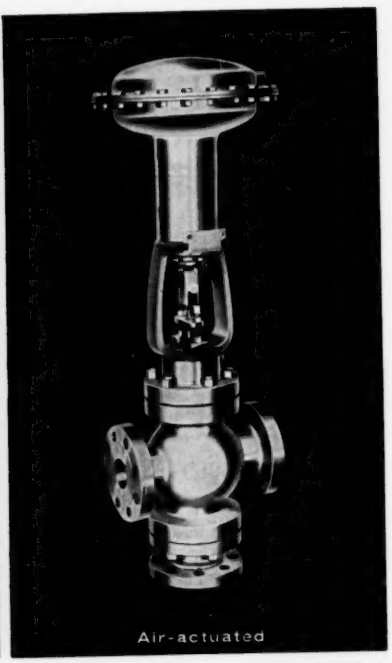

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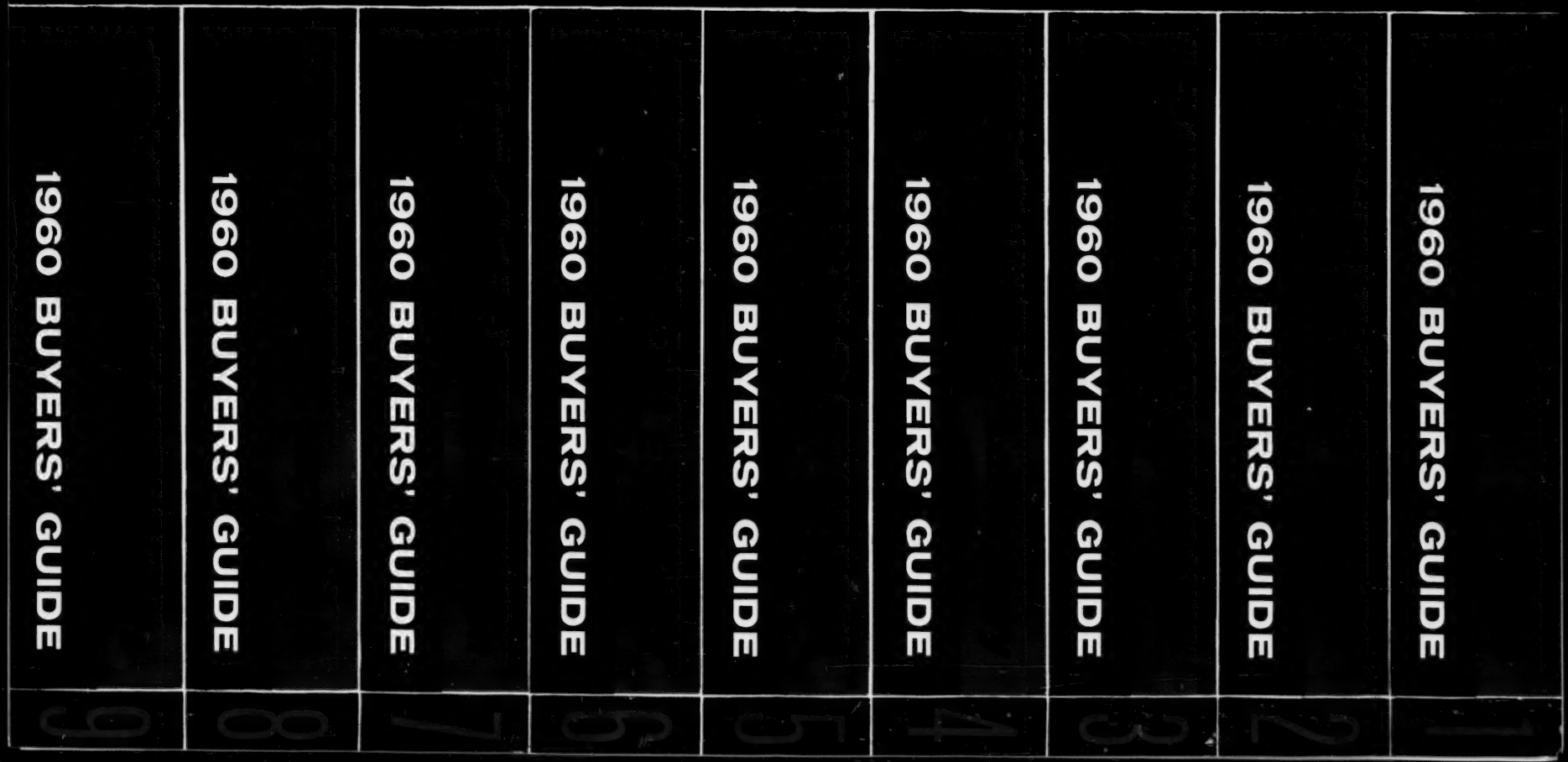

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about this

INSTRUMENTS AND CONTROL SYSTEMS

1960 BUYERS' GUIDE

THIS all-new 17th edition of the Guide incorporates several changes designed to make it more useful to you, the buyer of instruments and devices for measurement, inspection, testing, analysis, computing and automatic control.

About 2,000 companies cooperated to make this edition possible. Their returned questionnaires provide the basis for all the listings herein. Some 319 companies, by advertising herein, further supported this guide to all industry buyers of instruments, controls, systems, components and accessories.

In using this directory, you are urged to consult the advertisements. They're positioned to enable your quick reference—they contain valuable data which can save you time and correspondence in product selection and procurement.

First among the new features is the division of the main index section into nine separate departments. This enables more rapid location of suppliers products peculiar to particular applications. The Table of Contents on page one lists all of the separate sections and their locations. A "title page" precedes each section—describes the type of equipment covered.

A complete Product Index is also included in this edition. It contains all of the headings which appear in the nine catalog sections, plus "reference" headings to aid in location of specific items.

Recommended procedure for using the 1960 Buyers' Guide suggests that you look first in the Product Index for the specific item in which you are interested—then turn to the catalog to which that item directs you. There you will find not only a list of the manufacturers and suppliers of the specific item, but also manufacturers of associated and allied equipments.

To find the addresses of the manufacturers and suppliers, then turn to the Directory of Manufacturers, at the back of the book. It will pay to contact more than one of the companies listed as sources for the item desired, as each has its specialties and specialized features.

Another new feature designed to facilitate your buying activities—for the first time, manufacturers' telephone numbers are included with their listings in the Directory of Manufacturers. Where no number is listed, none was provided by the manufacturer.

A valuable feature from last year's edition has also been retained this year. Manufacturers' representatives and sales offices are listed for those reps and manufacturers who purchased this service. It further helps you find close-to-home sources of supply, service, and information.

Throughout this directory, listings are by *basic variable.* Therefore, look for "pressure," "temperature," "flow," etc. DO NOT look for "instruments," "gages," "meters," "indicators," etc. An exception to this is the listing of certain general-purpose devices, such as "recorders."

This 1960 I&CS Buyers' Guide provides you a more complete and serviceable directory than any previous edition. But . . . as it is all-new, a few omissions will no doubt come to light. Your editors would much appreciate your reporting these so that the next edition may be that much closer to perfection.

PRODUCT INDEX

This PRODUCT INDEX will help you find the product listings in the several catalogs. All products are listed here in alphabetical order. First find the product in which you are interested; directly under the product you will see a catalog number. Turn to this catalog to find the names of the firms making that product. When you have the company names, turn to pages 197 to 219 to find the addresses for the companies.

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DETECTORS, Gamma Ray, see Radioactivity (Cat. 4)

DETECTORS, Gas including Methane and Mine Gases, see Gas Analyzers (Cat. 1)

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GAGE TESTERS, Deadweight, see Pressure Instrument Calibrators, Deadweight (Cat. 1)

GAGES, Bourdon, see Pressure Gages (Cat. 1)

GAGES, Caliper (Dial), see Dimensional Gages (Cat. 6)

GAGES, Coating Thickness, see Dimensional Gages (Cat. 6)

GAGES, Comparator, see Dimensional Gages (Cat. 6)

GAGES, Compression, see Engine Test (Cat. 6), also Load (Cat. 1), also Weight (Cat. 1)

GAGES, Concentricity, see Dimensional Gages (Cat. 6)

GAGES, Contour, see Dimensional Gages (Cat. 6)

GAGES, Deadweight, see Pressure Instrument Calibrators, Deadweight (Cat. 1)

GAGES, Depth, Linear, see Dimensional Gages (Cat. 6)

GAGES, Depth, Navigational, see Depth Indicators (Cat. 5)

GAGES, Draft, see Draft Instruments (Cat. 1)

GAGES, Drill Grinding, see Dimensional Gages (Cat. 6)

GAGES, Feeler, see Dimensional Gages (Cat. 6)

GAGES Film Thickness, see Dimensional Gages (Cat. 6)

GAGES, Gas, see Pressure or Vacuum Gages (Cat. 1)

GAGES, Hydrostatic, see Level (Cat. 1)

GAGES, Internal, Dial, see Dimensional Gages (Cat. 6)

GAGES, Ionization, see Radioactivity Detectors (Cat. 4)

GAGES, Limit, see Dimensional Gages (Cat. 6)

GAGES, Mercury, see Manometers (Cat. 1)

GAGES, Micrometer, see Dimensional Gages (Cat. 6)

GAGES, see Object of Measurement and Control

GAGES, Optical, see Dimensional Gages (Cat. 6)

GAGES, Paper Thickness, see Dimensional Gages, also Paper (Cat. 6)

GAGES, Profile, see Dimensional Gages (Cat. 6)

GAGES, Rain, see Hydrologic Instruments (Cat. 5)

GAGES, Rifle Bore, see Dimensional Gages (Cat. 6)

GAGES, Ring, see Dimensional Gages (Cat. 6)

GAGES, Screw Thread, see Dimensional Gages (Cat. 6)

GAGES, Snap, see Dimensional Gages (Cat. 6)

GAGES, Strain, see Strain Gages (Cat. 1)

GAGES, Surface Finish, see Dimensional Gages (Cat. 6)

GAGES, Tank, see Level (Cat. 1)

GAGES, Telescoping, see Dimensional Gages, also Telescopes (Cat. 6)

GAGES, Thickness, see Dimensional Gages (Cat. 6)

GAGES, Thickness, Eddy Current, see Thickness Gages (Cat. 6)

GAGES, Thickness, Magnetic, see Thickness Gages (Cat. 6)

GAGES, Thickness, Ultrasonic, see Thickness Gages (Cat. 6)

GAGES, Thread, see Dimensional Gages (Cat. 6)

GAGES, Tide, see Hydrologic Instruments (Cat. 5)

GAGES, Venturi, see Flowmeters, Inferential (Cat. 1)

GAGES, Wind, see Meteorological Instruments (Cat. 5)

GAGES, Wire Measuring, see Dimensional Gages (Cat. 6)

GALVANOMETER MOVEMENTS (Cat. 8)

GALVANOMETERS, AC, Astatic, DC, Magnetostriction and Piezoelectric, Reflecting, Suspension Strip, Vacuum-tube, Vibration (Cat. 3)

GAS ANALYZERS, air (Cat. 1)

GAS ANALYZERS, Ammonia (Cat. 1)

GAS ANALYZERS, Carbon Dioxide, and/or Carbon Monoxide (Cat. 1)

GAS ANALYZERS, Flue Gas, see Gas Analyzers, CO, O_2, etc. (Cat. 1)

GAS ANALYZERS, Hydrogen, Hydrogen Sulphide, Nitric Oxide, etc. (Cat. 1)

GAS ANALYZERS, Nitrogen (Cat. 1)

GAS ANALYZERS, Orsat (Cat. 1)

GAS ANALYZERS, Oxygen (Cat. 1)

GAS ANALYZERS, Sulphur Dioxide (Cat. 1)

GAS DENSITY METERS, see Density (Cat. 1 and 6)

GAS DISTRIBUTION SYSTEM INSTRUMENTS, including Gas Station Meters, Pipe Line Instrumentation, Pressure Regulators, Station Instrumentation, etc. (Cat. 1)

GAS LEAK INDICATORS, see Leak (Cat. 1)

GAS METERS, see Flowmeters (Cat. 1)

GAS METERS, Positive, see Flowmeters, Positive Displacement (Cat. 1)

GAS and VAPOR DISCHARGE TUBES, see Tubes, Discharge (Cat. 8)

GASOLINE MILEAGE TESTERS, see Mileage Indicators (Cat. 7)

GAUSSMETERS, see Magnetic Field Strength (Cat. 3)

GEAR ASSEMBLIES, see Gears, Precision (Cat. 8)

GEAR DEVICES, Water Meter and Register (Cat. 8)

GEAR SEGMENTS, see Gears (Cat. 8)

GEAR TEST INSTRUMENTS—Cat. 6, (see also Dimensional Gages Cat. 6)

GEAR TRAINS Reducing, High Precision, see Gears Precision, including Gear Trains (Cat. 8)

GEARS, Precision, including Gear Trains, Gear Hubs, Pinions, etc. (Cat. 8)

GEIGER-MUELLER COUNTERS, see Radioactivity (Cat. 4)

GENERATOR SETS, Automatic Engine-driven, for Emergency Power (Cat. 3)

GENERATORS, AC, Complex Wave, DC, Pulse, Signal, Square Wave; Sweep Frequency including AF, RF, UHF; Synchro (Cat. 3)

GEOPHONES (Cat. 7)

GEOPHYSICAL INSTRUMENTS, including Geophysical Shock Recorders, Gravity Indicators, Geophysical Prospecting Equipment—Cat. 7, (see also Radioactivity—Cat. 4)

GERMANIUM DIODES, see Diodes, Germanium (Cat. 8)

GERMANIUM RECTIFIERS, see Rectifiers, Dry Disc (Cat. 8)

GLARE METERS, see Gloss Meters (Cat. 4)

GLASS BLOWING and **GLASS BURNERS,** see Glass Working Equipment (Cat. 4)

GLASS, Circles and Ovals for Instruments (Cat. 9)

GLASS, Colored, for Filters (Cat. 9)

GLASS, Heat Absorbing and Heat Tempered (Cat. 9)

GLASS, Infrared Transmitting (Cat. 9)

GLASS, Low Reflecting Surfaces (Cat. 9)

GLASS, Photosensitive (Cat. 9)

GLASS, Raw, Optical and Molded Blanks (Cat. 9)

GLASS, Shatterproof for Instruments (Cat. 9)

GLASS TEST INSTRUMENTS, including Hardness, Immersion Liquids, Refraction, Strain, etc. (—Cat. 6, see also Refractometers—Cat. 4)

GLASS TUBING, Heat Resisting (Cat. 9)

GLASS TUBING, Precision Bore (Cat. 9)

GLASS TUBING, Ultraviolet Transmitting, including Opaque to Visible Lighting (Cat. 9)

GLASS WORKING EQUIPMENT, including Blowing Cutting, etc. (Cat. 4)

GLASSES, Cover (Cat. 9)

GLASSWARE, Laboratory & Industrial (Cat. 9)

GLOSS METERS—Cat. 4, (see also Paint Test Instruments—Cat. 4)

GLOW TUBES, Voltage Regulators, see Voltage Regulators (Cat. 3)

GLUE TESTERS, see Adhesion (Cat. 6)

GOLD (Cat. 9)

GONIOMETERS (Cat. 4)

GOVERNORS, Air, see Pressure Regulators, Air (Cat. 1)

GOVERNORS, Engine, see Engine Governors (Cat. 1)

GOVERNORS, Escapement Controlled, see Clockworks (Cat. 8)

GOVERNORS, Gas, see Gas Distribution System Instruments, also Pressure Controllers (Cat. 1)

GOVERNORS, see Object of Control

GOVERNORS, Pump, see Pump Governors (Cat. 1)

GOVERNORS, Steam, see Engine Governors (Cat. 1)

GOVERNORS, Turbine, see Engine Governors (Cat. 1)

GRADUATING MACHINES, see Machines, Dividing (Cat. 6)

GRAIN TEST INSTRUMENTS (Cat. 4)

GRANULAR MATERIALS, Level, see Level (Cat. 1)

GRANULAR MATERIALS FLOW, see Flow Instruments, Granular Material (Cat. 1)

GRANULAR MATERIALS MEASUREMENTS, see Particle Instruments (Cat. 4)

GRATING, Diffraction, Echelon (Cat. 4)

GRAVIMETERS, see Geophysical Instruments (Cat. 7)

GRAVITOMETERS, see Specific Gravity (Cat. 4)

GRAVITY, see Geophysical or Specific Gravity (Cat. 4 and 7)

GREASE TESTING INSTRUMENTS (Cat. 4)

GRINDERS, Precision Surface, see Machines (Cat. 9)

GRINDING FINISH GAGES, see Dimensional Gages (Cat. 6)

GROUND DETECTORS (Cat. 3)

GROUND RESISTANCE INSTRUMENTS, see Resistance Indicators, Ground (Cat. 3)

GYRO PILOT, see Aircraft Instruments (Cat. 5)

GYRO STABILIZERS (Cat. 5)

GYROS AND GYROSCOPES, Vertical and Directional Rate (Cat. 5)

HAIRSPRINGS, see Springs (Cat. 9)

HARDNESS INDICATORS for Plastic Films, see Plastic Test Instruments (Cat. 6)

HARDNESS PENETRATORS, Diamond (Cat. 6)

HARDNESS TESTING MACHINES, including Brinell (Cat. 6)

HARDWARE, Instrument and Electronic Equipment, including Chassis, Handles, Hinges, Keys, Knobs, Legs, Locks (Cat. 8)

HARMONIC ANALYZERS, see Spectrum Analyzers (Cat. 3)

HEAT FLOW, instruments and transducers (Cat. 1)

HELIOSTATS (Cat. 5)

HERMETIC SEALS (Cat. 8)

HERMETIC SEALS, see Terminals, Hermetic (Cat. 8)

HIGH ALTITUDE TEST and **CALIBRATION CHAMBERS,** see Environmental Test Chambers (Cat. 1)

HIGH-FREQUENCY APPARATUS, including RF Heaters (Cat. 3)

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HOUR COUNTERS, see Time, also Timers (Cat. 1)

HUMIDISTATS (Cat. 1)

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HUMIDITY CONTROLLERS (Cat. I)

HUMIDITY INSTRUMENTS, Conductivimetric (Cat. I)

HUMIDITY INSTRUMENTS, Hydrometric (Cat. I)

HUMIDITY INSTRUMENTS, Hygroscopic, including Hair, Plastics, etc. (Cat. I)

HUMIDITY INSTRUMENTS, Psychrometric, indicating and/or Recording (Cat. I)

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HYDROGEN-ION INSTRUMENTS, see pH Cat. I)

HYDROLOGIC INSTRUMENTS, including Rain Gages (Cat. 5)

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HYGROMETERS, see Humidity Instruments (Cat. I)

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IGNITION INDICATORS, see Engine Test (Cat. 6)

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ILLUMINATION INSTRMEUNTS, including Exposure, Meters, Foot Candle Meters, Photometers, etc. (Cat. 3)

ILLUMINOMETERS, Macbeth (Cat. 3)

IMMERSION LIQUIDS for Inspection of Glass, see Glass Test (Cat. 6)

IMPACT RECORDERS (Cat. 6)

IMPACT TESTING MACHINES, including Pendulum Type (Cat. 6)

IMPEDANCE MEASURING INSTRUMENTS, including Resistance Meters, Z-Angle Meters, etc. (Cat. 3)

INCLINOMETER TUBES (Cat. 5)

INCLINOMETERS, see Aircraft Instruments (Cat. 5)

INCLINOMETERS, Bore Hole (Cat. 7)

INCLINOMETERS, Lateral, Aviation, see Aircraft Instruments (Cat. 5)

INCLINOMETERS, Ship, see Marine Instruments (Cat. 5)

INDICATOR LIGHTS, see Pilot Lights (Cat. 8)

INDICATORS, see Object of Measurement

INDUCTORS, Fixed (Cat. 3)

INDUCTANCE INDICATORS (Cat. 3)

INFORMATION SYSTEMS, see Data Processing Systems (Cat. 2)

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INKS, Recording (Cat. 9)

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INSPECTION DEVICES, Electrical, see Circuit Testers, also Insulation Testers, also Resistance Indicators, etc. (Cat. 3)

INSPECTION DEVICES, Insulated Wire, see Insulation Testers (Cat. 3)

INSPECTION DEVICES, Optical Projection, see Dimensional Gages (Cat. 6)

INSPECTION DEVICES, Smoothness, see Dimensional Gages, Surface (Cat. 6)

INSPECTION DEVICES, Thickness, see Dimensional Gages, also Thickness Gages (Cat. 6)

INSPECTION EQUIPMENT, Welding, see Flaw Detectors (Cat. 6)

INSPECTION EQUIPMENT, Bore Hole, see Telescopes, Bore Inspection (Cat. 6)

INSPECTION EQUIPMENT, Nondestructive, see Flaw Detectors (Cat. 6)

INSPECTION, Glass and Quartz, see Glass Test (Cat. 6)

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INSTRUMENT TUBING and FITTINGS, see Tubing and Fittings (Cat. 8 and 9)

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INSULATION RESISTANCE INDICATORS, see Resistance (Cat. 3)

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INSULATORS, Ceramic, including Special Shapes (Cat. 8)

INSULATORS, Thermocouple, see Thermocouple Insulators (Cat. 8)

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KOVAR, Wire and Stampings (Cat. 9)

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LENSES, Optical including Fused Quartz, see Optical Parts (Cat. 8)

LEVEL CONTROLLERS, Bin and Bulk Material (Cat. I)

LEVEL CONTROLLERS, INDICATORS and/or RECORDERS Liquid—Cat. I, (see also Valves, Float—Cat. I)

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LIGHT METERS, see Illumination (Cat. 9)

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LIGHT WAVE MEASURING EQUIPMENT, see Spectrum Analyzers (Cat. 4)

LIGHTING CONTROLLERS, see Illumination Controllers (Cat. I)

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LIGHTS, see Pilot Lights (Cat. 8)

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LIQUID LEVEL, Indicators or Recorders, see Level, Liquid (Cat. I)

LIQUID METERS, Inferential Type, see Flowmeters, Inferential Type (Cat. I)

LIQUID METERS, Positive Types, see Flowmeters, Positive Displacement (Cat. I)

LOAD CELLS—Cat. I, (see also Pressure, also Weight—Cat. I)

LOAD CONTROLLERS, Weight, see Weight (Cat. I)

LOAD INDICATORS and/or RECORDERS AND CONTROLLERS, Electrical—Cat. 3, (see also Power Factor—Cat.3)

LOCATORS, Fault, Electrical Resistance, see Fault Locators (Cat. 3)

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LOGGERS, Automatic Data, see Data Processing (Cat. 2)

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LUBRICANTS, Instrument, including Pivot, High Temperature, Low Temperature, etc. (Cat. 9)

LUMINESCENT MATERIALS, including Fluorescent and Phosphorescent Paints, Radioactive Phosphors, Radium Paint, etc. (Cat. 9)

LUSTER METERS, see Gloss Meters (Cat. 4)

MACHINE TOOL CONTROLLERS, including Electronic Control Systems (Cat. I)

MACHINES, Automatic Circuit Assembly, including Automatic Wiring, Automatic Component Assembly, etc. (Cat. 9)

MACHINES, Coil Winding (Cat. 9)

MACHINES, Dividing (Cat. 6)

MACHINES, Engraving (Cat. 9)

MACHINES, Filling, including Bag, Bottle, Carton, etc. (Cat. I)

MACHINES, Jewelers' Lathes etc., see Jewelers' Lathes (Cat. 9)

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MACHINES, Marking (Cat. 9)

MACHINES, Optical, Grinding, Polishing, and Edging (Cat. 9)

MACHINES, Precision Drilling Tapping, and Lathes (Cat. 9)

MACHINES, Presses, including Laboratory, Pellets (Cat. 9)

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MAGNETIC DRUM MEMORIES, see Memories (Cat. 2)

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MAGNETIC INSPECTORS, see Flaw Detectors, Magnetic (Cat. 6)

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MALT TESTING APPARATUS (Cat. 4)

MANGANIN RESISTANCE TUBES, see Resistance Wire (Cat. 9)

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MANOMETERS, Electrical Contact (Cat. I)

MANOMETERS, Glass including Micro, Raised Well Type, Remote Reading, U-Tube, Test, etc. (Cat. I)

MANOMETERS, High Pressure (Cat. I)

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MARINE INSTRUMENTS, including Steering Systems, Logs, etc.—Cat. 5, (see also Barometers—Cat. 7, also Compasses—Cat. 5)

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MARKING DEVICES (Cat. 8)

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MEDICAL EQUIPMENTS including Electromedical (Cat. 4)

MEGOHMMETERS, see Resistance, Indicators, Megohms (Cat. 3)

MELTING POINT APPARATUS (Cat. 4)

MEMORIES, Electrostatic, including C-R Tubes—Cat. 2, (see also Computers—Cat. 2)

MEMORIES, Magnetic, including Tape, Drum, Cores—Cat. 2, (see also Computers—Cat. 2)

MERCURY (Cat. 9)

METAL DETECTORS, including Pipe Locators (Cat. 6)

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METALS, Clad, including Silver Clad (Cat. 9)

METALS, Powdered—Cat. 9, (see also Magnetic Material—Cat. 9)

METALS, Thermostatic, see Thermostatic (Cat. 9)

METER PROVERS, Gas, see Flow Provers (Cat. I)

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METERS, Batching, see Flowmeters, Positive Displacement (Cat. I)

METERS, Compressed Air, see Flowmeters (Cat. I)

METERS, Consumer's Gas, see Flowmeters, Positive Displacement (Cat. I)

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METERS, Decibel, see Sound Level (Cat. 3)

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METERS, Electronic, see specific Instrument—Voltmeters, Oscilloscopes, etc.

METERS, Footage, see Counters, Footage (Cat. I)

METERS, Foot-candle, see Illumination (Cat. 3)

METERS, Frequency Modulation, see Modulation Indicators (Cat. 3)

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METERS, Gas Station, see Gas Distribution System Instruments (Cat. I)

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METERS, Light, see Illumination Instrument (Cat. 3)

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METERS, see Object of Measurement, for example Flowmeters

METERS, Orifice, see Flowmeters, Inferential (Cat. I)

METERS, Oxygen, see Gas Analyzers (Cat. I)

METERS, Sewage, see Flowmeters, also Waste (Cat. I)

METERS, Sight Flow, see Flowmeters, Sight (Cat. I)

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MICROMETERS, Optical, see Dimensional Gages, Optical (Cat. 6)

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MICROSCOPES, Electron (Cat. 4)

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MOTOR, Clock, see Clockworks (Cat. 8)

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SCREW DRIVERS, Instrument (Cat. 9)

SCREW DRIVERS, Torque, see Wrenches, Torque (Cat. 9)

SCREW MACHINES, see Machines, Screw (Cat. 9)

SCREW THREAD GAGES, see Dimensional Gages (Cat. 6)

SCREWS, Instrument (Cat. 9)

SCREWS, Lead, Precision (Cat. 9)

SCREWS, Stainless Steel (Cat. 9)

SEGER CONES, see Pyrometric Cones (Cat. 1)

SEISMOLOGICAL INSTRUMENTS, including Seismographs (Cat. 5)

SERVO SYSTEM ANALYZERS (Cat. 5)

SERVO VALVES, Hydraulic (Cat. 1)

SERVOMECHANISMS, including Servo Systems, Kits—Cat. 5, (see also Servomotors—Cat. 5, also Clutches, and Gears—Cat. 8)

SERVOMECHANISMS, Digital, including Digital Positioners (Cat. 5)

SERVOMOTORS, Electric Motor and/or Solenoid (Cat. 5)

SERVOMOTORS, Hydraulic, Mechanical, and Pneumatic (Cat. 5)

SEXTANTS, see Navigational Instruments (Cat. 5)

SHAFTING, Flexible (Cat. 9)

SHAKE TABLES, see Vibration Test (Cat. 1)

SHEETS, Beryllium Copper, Brass, Bronze, Copper (Cat. 9)

SHEETS, Columbium, Molybdenum (Cat. 9)

SHIELDING, MAGNETIC, see Magnetic (Cat. 8)

SHIELDS, Lead (Cat. 9)

SHIELDS, Transformer (Cat. 9)

SHIELDS, Tube (Cat. 9)

SHIP LOGS, see Marine Instruments (Cat. 5)

SHIPBORNE INSTRUMENTS, see Marine Instruments (Cat. 5)

SHOCK MOUNTINGS, see Mountings (Cat. 8)

SHUNTS, including Shunt Meters, Ayrton (Cat. 3)

SIEVE SHAKERS, (Cat. 6)

SIEVES, Testing (Cat. 6)

SIGHT FLOW BUBBLERS (Cat. 1)

SIGHT FLOW INDICATORS, see Flowmeters, Sight (Cat. 1)

SIGHTS, Gun, Telescopic (Cat. 5)

SIGNAL GENERATORS, see Generators (Cat. 3)

SIGNAL LIGHTS, see Pilot Lights (Cat. 8)

SIGNALING DEVICES, Automatic, see Monitors (Cat. 1)

SILICA Fused and/or Vitreous (Cat. 9)

SILVER, see Precious Metals (Cat. 9)

SIMULATORS, Flight including Flight Tables (Cat. 5)

SINE BARS, see Dimensional Gages (Cat. 6)

SLIDERULES, Engineering Calculation (Cat. 7)

SLIP RINGS (Cat. 9)

SMOKE DENSITY INDICATORS and/or RECORDERS (Cat. 1)

SMOOTHNESS RECORDERS, see Dimensional Gages, Surface (Cat. 6)

SNUBBERS, see Pressure Snubbers (Cat. 1)

SOCKETS, Lamp, Printed Circuit, Transistor, Tube, and Turret (Cat. 9)

SOCKETS, Thermometer, see Thermowells (Cat. 1)

SOFTNESS TESTERS (Cat. 6)

SOIL TESTERS (Cat. 6)

SOLAR BATTERIES, see Batteries, Solar (Cat. 8)

SOLDERING GUNS and IRONS (Cat. 9)

SOLDERS, Gold and/or Silver (Cat. 9)

SOLDERS, Hard (Cat. 9)

SOLDERS, Soft (Cat. 9)

SOLDERS, Special, including Flux-filled (Cat. 9)

SOLENOIDS—Cat. 8, (see also Relays—Cat. 8)

SOLENOIDS, Rotary (Cat. 8)

SOLENOIDS, Subminature (Cat. 8)

SORTING EQUIPMENT, including Gaging (Cat. 6)

SOUND ANALYZERS, including Noise (Cat. 3)

SOUND INDICATORS, including Noise Indicators and Noise Measuring Sets (Cat. 3)

SOUND LEVEL INDICATORS, including db Meters (Cat. 3)

SOUND PICKUPS, see Microphones (Cat. 8)

SOUND STANDARDS, see Standards, Sound (Cat. 3)

SOUNDING MACHINES AND LEADS (Cat. 5)

SOUNDING TUBES (Cat. 5)

SPARK PLUG TESTERS, see Engine Test (Cat. 6)

SPECIFIC GRAVITY BALANCES (Cat. 4)

SPECIFIC GRAVITY BOMBS (Cat. 4)

SPECIFIC GRAVITY BOTTLES (Cat. 4)

SPECIFIC GRAVITY CONTROLLERS, INDICATORS and RECORDERS (Cat. 1)

SPECTROGRAPHS (Cat. 4)

SPECTROMETERS (Cat. 4)

SPECTROMETERS, Infrared, Mass (Cat. 4)

SPECTROMETERS, X-ray, see Spectrographs (Cat. 4)

SPECTROPHOTOMETERS (Cat. 4)

SPECTROPHOTOMETERS, Ultraviolet (Cat. 4)

SPECTROSCOPES (Cat. 4)

SPECTROSCOPES, Quartz (Cat. 4)

SPECTROSCOPES, Stellar (Cat. 4)

SPECTRUM ANALYZERS, AF (Cat. 3)

SPECTRUM ANALYZERS, RF including Panoramic Adapters (Cat. 3)

SPECTRUM ANALYZERS, Optical (Cat. 4)

SPEED INDICATORS, RECORDERS and REGULATORS, including Speed Switches (Cat. 1)

SPEED REDUCERS and SPEED INCREASERS (Cat. 1)

SPEED SYNCHRONIZING INDICATORS (Cat. 1)

SPEEDOMETERS, see Speed (Cat. 1)

SPHEROMETERS (Cat. 6)

SPHYGMOMANOMETERS (Cat. 4)

SPRING TESTING MACHINES (Cat. 6)

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SPRINGS, FLAT (Cat. 9)

SPRINGS, Glass (Cat. 9)

SPRINGS, Hair and Hair Assemblies (Cat. 9)

SPRINGS, Helical (Cat. 9)

SPRINGS, Torsion (Cat. 9)

SPRINGS, Watch (Cat. 9)

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STATION CONTROL EQUIPMENT, see Electric Power Generation Instruments, also Gas Distribution System Instruments (Cat. 1)

STEAM GOVERNORS, see Boiler Room Instruments (Cat. 1)

STEAM METERS, see Flowmeters, Inferential Type (Cat. 1)

STEAM SPECIALTIES, see Boiler Room Instruments (Cat. 1)

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STEROSCOPES (Cat. 4)

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SULPHUR DIOXIDE INDICATORS, and or RECORDERS, see Gas Analyzers (Cat. 1)

SUNSHINE INDICATORS and/or RECORDERS (Cat. 5)

SUPERVISORY CONTROL EQUIPMENT and SYSTEMS, see Control Systems, also Telemetering (Cat. 1)

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SURFACE FINISH INSTRUMENTS, see Dimensional Gages, Surface (Cat. 6)

SURFACE FINISH SPECIMENS, see Standards, Surface Finish (Cat. 6)

SURFACE PLATES, Glass (Cat. 6)

SURFACE PLATES, Stone (Cat. 6)

SURFACE TENSION INSTRUMENTS (Cat. 4)

SURVEYING INSTRUMENTS, including Aneroid Type (Cat. 7)

SURVEYING INSTRUMENTS, Underground, for wells or bore holes —Cat. 7, (see also Geophysical Instruments—Cat. 7)

SURVEYOR CHAINS, see Surveying Instruments (Cat. 7)

SWITCHES, Air Operated (Cat. 8)

SWITCHES, Instrument, including Wiping, Setting, etc. (Cat. 8)

SWITCHES, Magnetic (Cat. 8)

SWITCHES, Mercury (Cat. 8)

SWITCHES, Pressure and Vacuum (Cat. 8)

SWITCHES, Pyrometer (Cat. 8)

SWITCHES, Rotary, including Shaft Motion Types (Cat. 8)

SWITCHES, Sealed (Cat. 8)

SWITCHES, Snap Action (Cat. 8)

SWITCHES, speed, see Speed (Cat. 1)

SWITCHES, Stepping, including Motors, Step Type—Cat. 8, (see also Relays—Cat. 8)

SWITCHES, Thermostatic (Cat. 8)

SWITCHES, Time (Cat. 8)

SYNCHROS, including Transmitters, Receivers, Differentials, Control Transformers, Receivers —Cat. 8, (see also Servomotors—Cat. 5)

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TACHOGRAPHS (Cat. 1)

TACHOMETER TESTERS (Cat. 6)

TACHOMETERS, Centrifugal (Cat. 1)

TACHOMETERS, Chronometric (Cat. 1)

TACHOMETERS, Electric and Electromagnetic (Cat. 1)

TACHOMETERS, Miscellaneous, including Cross Pendulum, Fly-ball, Ignition actuated, Tilting-ring—Cat. 1, (see also Frequency—Cat. 3.)

TACHOMETERS, Recording (Cat. 1)

TACHOMETERS, Speed Limit Control (Cat. 1)

TACHOMETERS, Stroboscopic (Cat. 1)

TACHOMETERS, Vibrating Reed (Cat. 1).

TACHOSCOPES (Cat. 1)

TAFFRAIL LOGS, Ship, see Marine Instruments (Cat. 5)

TAPE, Magnetic Recording (Cat. 2)

TAPE RECORDERS, see Recorders, Magnetic Tape (Cat. 2)

TAPES, Pressure Sensitive, including Symbols (Cat. 9)

TAPES, Steel—Cat. 6, (see also Dimensional Gages—Cat. 6)

TAPES, Surveyor, see Surveying Instruments (Cat. 7)

TELEGRAPHY, Automatic, including Reperforators, Tape Perforators, Tape Transmitters, Teleprinters, Teletypers (Cat. 2)

TELEMETERING SYSTEMS, Electrical, including Remote-Control Equipment (Cat. 1)

TELEMETERING SYSTEMS, Penumatic (Cat. 1)

TELEMETERING SYSTEMS, RF, including Microwave, Radio Remote Control (Cat. 1)

TELEMETERS, Surveying and Military, Optical (Cat. 5)

TELESCOPES, Alignment (Cat. 6)

TELESCOPES, Astronomical (Cat. 5)

TELESCOPES, Azimuth and/or Zenith (Cat. 5)

TELESCOPES, Bore and Internal Surface, Inspection (Cat. 6)

TELESCOPES, Laboratory (Cat. 4)

TELESCOPES, Reflection an/or Refracting (Cat. 5)

TELEVISION, Industrial (Cat. 1)

TEMPERATURE ALARM SYSTEMS (Cat. 1)

TEMPERATURE CALIBRATION EQUIPMENT (Cat. 1)

TEMPERATURE CONTROLLERS and REGULATORS (Cat. 1)

TEMPERATURE, INSTRUMENTS, see Thermometers, also Pyrometers (Cat. 1)

TEMPERATURE SENSITIVE PAINT AND CRAYONS (Cat. 1)

TEMPERATURE STANDARDS, see Standards, Temperature (Cat. 7)

TENDERNESS TESTERS, see Softness Testers (Cat. 6)

TENSILE TEST MACHINES, see Testing Machines (Cat. 6)

TENSIOMETERS (Cat. 6)

TENSION INDICATORS —Cat. 6, (see also Textile Test Instruments —Cat. 6)

TERMINALS, Blocks, Boards, and Shapes (Cat. 8)

TERMINALS, Hermetic (Cat. 8)

TEST CHAMBERS, see Environmental Test Chambers (Cat. 1)

TEST CLIPS, see clips (Cat. 8)

TEST SETS, Diode, see Diode Test Sets (Cat. 3)

TEST WEIGHTS, see Weights and Measures (Cat. 7)

TESTERS, see the Object of Test

TESTERS, AIR Speed Indicators, see Aircraft Instrument Testers (Cat. 5)

TESTERS, Altimeters, see Aircraft Instrument Testers (Cat. 5)

TESTERS, Condenser, see Capacitance Indicators (Electrical)—Cat. 3, or Boiler Room Instruments (Process)—Cat. 1

TESTERS, Deadweight, see Pressure Instrument Calibrators, Deadweight (Cat. 6)

TESTERS, Dew Point, see Humidity Instruments (Cat. 1)

TESTERS, Fuel, see Gas Analyzers (Cat. 1), Coal Test, etc. (Cat. 4)

TESTERS, Moisture, see Moisture (Cat. 4), also Environmental Test (Cat. 1)

TESTERS, Mullen, see Bursting Testing (Cat. 6)

TESTERS, Non-destructive, Electrical, for Physical Properties (Cat. 6)

TESTING MACHINES, Bursting, see Bursting Testing Machines (Cat. 6)

TESTING MACHINES, Fatigue, see Fatigue (Cat. 6)

TESTING MACHINES, Glass Strain, see Glass Test (Cat. 6)

TESTING MACHINES, Gummed Tape, Paper, see Paper Test (Cat. 6)

TESTING MACHINES, High Pressure, see Bursting Testing Machines (Cat. 6)

TESTING MACHINES, Knit Goods, see Textile Testing (Cat. 6)

TESTING MACHINES, Leather, see Leather Testing (Cat. 6)

TESTING MACHINES, Miscellaneous, including Alternating Stress, Bending, Compression, Creep, Deflection, Ductility, Impact, Pendulum, Stiffness and Bending, Stretch, etc.—Cat. 6, (see also Testing Machines, Universal—Cat. 6)

TESTING MACHINES, Paper, see Paper Testing (Cat. 6)

TESTING MACHINES, Vibration, see Vibration (Cat. 1)

TESTING MACHINE (UNIVERSAL) CALIBRATORS, including Proving Rings (Cat. 6)

TESTING MACHINES, Universal, Dead Weight Beam (Cat. 6)

TESTING MACHINES, Universal, Hydraulic (Cat. 6)

TESTING MACHINES, Universal, Spring Dynamometer (Cat. 6)

TESTING MACHINES, Wire, see Wire Testing (Cat. 6)

TESTING SETS, see the Object of Measurement and Test

TESTING SETS, Electrical, see Circuit Testers (Cat. 3)

TESTING SETS, Meters, Electrical, see Electrical Instrument Calibrators (Cat. 3)

TESTING SETS, Water, see Water Analysis (Cat. 4)

TEXTILE TEST INSTRUMENTS and MACHINES (Cat. 6)

THEODOLITES, Magnetic (Cat. 5)

THEODOLITES, Pilot Balloon (Cat. 5)

THERMISTORS (Cat. 8)

THERMO-AMMETERS, see Ammeters (Cat. 3)

THERMOCOUPLE EXTENSION WIRE in Multiple Pair Cables (Cat. 8)

THERMOCOUPLE INSULATORS (Cat. 8)

THERMOCOUPLE WELLS, see Thermowells (Cat. 1)

THERMOCOUPLE WIRE and COMPONENTS, including Extension Lead Wire (Cat. 8)

THERMOCOUPLES, Base Metal—Cat. 1, (see also Wire, Thermocouple —Cat. 9)

THERMOCOUPLES, Contact Type—Cat. 1, (see also Thermometers, Surface—Cat. 1)

THERMOCOUPLES, Immersion (Cat. 1)

THERMOCOUPLES, Rare Metal (Cat. 1)

THERMOCOUPLES, Vacuum (Cat. 8)

THERMOHYDROMETERS, see Hydrometers (Cat. 4)

THERMOMETER TESTERS, see Temperature Calibration (Cat. 1)

THERMOMETER TEST WELLS, see Thermowells (Cat. 1)

THERMOMETER TUBES, see Thermowells (Cat. 1)

THERMOMETERS, Dial, Bimetal (Cat. 1)

THERMOMETERS, Dial, Gas, Mercury, Organic Liquids filled, or Vapor-pressure (Cat. 1)

THERMOMETERS, Electrical Resistance, Indicating, Recording and/or Controlling (Cat. 1)

THERMOMETERS, Indicating, Glass, including Mercury, Spirit (Cat. 1)

THERMOMETERS, Indicating, Pressure-spring (Cat. 1)

THERMOMETERS, Maximum and Minimum Register.ng (Cat. 1)

THERMOMETERS, Recording and/or Controlling, Filled Systems (Cat. 1)

THERMOMETERS, Surface (Cat. 1)

THERMOMETERS, Thermistor—Cat. 1, (see also Thermistors —Cat. 8)

THERMOPILES, see Radiation Pickups (Cat. 4)

THERMOSTATIC ELEMENTS and Metals, including Bimetallic Materials, Springs, Strips, Fabricated Parts, etc. (Cat. 9)

THERMOSTATS (Cat. 1)

THERMO-VOLTMETERS, see Voltmeters, Thermo (Cat. 3)

THERMOWELLS (Cat. 1)

THICKNESS GAGES (Cat. 6)

THICKNESS GAGES, Radiation (Cat. 6)

THICKNESS GAGES, Ultrasonic (Cat. 6)

THREAD GAGES, see Dimensional Gages (Cat. 6)

THREAD MEASURING WIRES, see Wires, Thread Measuring (Cat. 6)

THYRATRONS, see Tubes, Thyratron (Cat. 8)

TIDE GAGES, see Hydrologic Instruments (Cat. 5)

TIME CONTROLLERS, see Timers (Cat. 1)

TIME INDICATORS, see Clocks, also Watches, (Cat. 1)

TIME INTERVAL APPARATUS, see Counters, also Timers (Cat. 1)

TIME RECORDERS, including Running Time, Time Operation, Time Totalizers, etc. (Cat. 1)

TIME STUDY APPARATUS (Cat. 1)

TIMERS, including Automatic Reset, Cycle Interval—Cat. 1, (see also Program Controllers—Cat.1)

TIMERS, Microsecond—Cat. 1, (see also Counters, Electronic—Cat. 1)

TIN RIBBON, Block (Cat. 9)

TITRATION APPARATUS, Electrometric (Cat. 4)

TITRATION APPARATUS, Manual (Cat. 4)

TITROMETERS (Cat. 4)

TONG AMMETERS, see Ammeters (Cat. 3)

TOOLMAKER'S FLATS (Cat. 6)

TOOLS, Precision (Cat. 9)

TOPOGRAPHIC INSTRUMENTS, see Surveying Instruments (Cat. 7)

TORQUE CONTROL EQUIPMENT and GAGES (Cat. 1)

TORQUE TESTERS (Cat. 6)

TOTALIZERS, Demand (Cat. 1)

TOTALIZERS, Electric Energy (Cat. 1)

TOTALIZERS, Fluid Flow and/or Gas Flow, see Flow Totalizers (Cat. 1)

TOTALIZERS, Running Time, see Time Recorders (Cat. 1)

TRANSDUCERS. Note: A transducer converts one form of POWER into another. For numerous primary measuring devices see the correct headings under the measurables; e.g. Displacement Pickups, Flow Pickups, Pressure Pickups, etc.

TRANSDUCERS, Ultrasonic (Cat. 8)

TRANSFORMERS, Ajustable, see Transformers, Variable (Cat. 8)

Transformers, Constant Voltage—Cat. 8, (see also Voltage Regulators —Cat. 3)

TRANSFORMERS, Differential, see Displacement Pickups, Differential Transformers (Cat. 1)

TRANSFORMERS, High Frequency (Cat. 8)

TRANSFORMERS, Impedance (Cat. 8)

TRANSFORMERS, Input, Output, and Interstage, including AF, IF, and RF (Cat. 8)

TRANSFORMERS, Instrument including Current, and/or Potential, Laboratory (Cat. 8)

TRANSFORMERS, Insulation Testing (Cat. 8)

TRANSFORMERS, Isolation (Cat. 8)

TRANSFORMERS, Microwave (Cat. 8)

TRANSFORMERS, Phasing (Cat. 8)

TRANSFORMERS, Power (Cat. 8)

TRANSFORMERS, Pulse (Cat. 8)

TANSFORMERS, Saturable., see Amplifiers (Cat. 3)

TRANSFORMERS, Split Core (Cat. 8)

TRANSFORMERS, Ultrasonic (Cat. 8)

TANSFORMERS, Variable, including Auto-transformers (Cat. 8)

TRANSFORMERS, Variable, Voltage Testing (Cat. 8)

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TRANSFORMERS, Voltage Regulating, see Transformers, Constant Voltage (Cat. 8)

TRANSISTOR TESTING SETS (Cat. 3)

TRANSISTORS (Cat. 8)

TRANSITS, Engineer's, see Surveying Instruments (Cat. 7)

TRANSITS, Pocket (Cat. 7)

TRANSMITTERS, see Telemetering, also Pressure Transmitters, also Flow Transmitters (Cat. 1)

TRIMMERS, Capacitor, see Capacitors (Cat. 8)

TRUCK-MILEAGE RECORDERS, see Mileage Indicators (Cat. 7)

TUBE TESTERS, Electron (Cat. 3)

TUBES, Cathode Ray, including Display, Camera, Storage, etc. (Cat. 8)

TUBES, Discharge, Gas and Vapor, including Argon, Mercury, Neon, Sodium, etc. (Cat. 8)

TUBES, Electrometer (Cat. 8)

TUBES, Electron, Vacuum (Cat. 8)

TUBES, Geiger-Mueller—Cat. 8, (see also Counters, G-M—Cat. 4)

TUBES, Glow—Cat. 8, (see also Tubes, Discharge—Cat. 8)

TUBES, Ignitron (Cat. 8)

TUBES, Klystron (Cat. 8)

TUBES, Magnetron (Cat. 8)

TUBES, Nessler (Cat. 4)

TUBES, Photosensitive, including Phototubes and Photocells (Cat. 8)

TUBES, Polariscope (Cat. 4)

TUBES, Pyrometer Protection, see Thermowells (Cat. 1)

TUBES, Thyratron (Cat. 8)

TUBES, Travelling Wave—Cat. 8, (see also Microwave Equipment—Cat. 3)

TUBES, Ultra-Violet Light, see Light Sources (Cat. 4)

TUBES, Vacuum, see Tubes, Electron, Vacuum (Cat. 8)

TUBES, Voltage Regulator, see Tubes, Discharge (Cat. 8), also Current Regulators (Cat. 8)

TUBES, X-ray (Cat. 8)

TUBING, ARMORED, see Tubing, Capillary (Cat. 9), also Tubing, Flexible, Multiple Tube Bundles (Cat. 8)

TUBING, Bourdon (Cat. 9)

TUBING, Capillary (Cat. 9)

TUBING, Ceramic (Cat. 9)

TUBING, Fibre (Cat. 9)

TUBING, Flexible (Cat. 9)

TUBING, Flexible, Multiple Tube Bundles (Cat. 8)

TUBING, Fused Quartz (Cat. 9)

TUBING, Glass Fibre, Insulation (Cat. 9)

TUBING, Laminated Phenolic (Cat. 9)

TUBING, Low Coefficient of Expansion (Cat. 9)

TUBING, Mica (Cat. 9)

TUBING, Miscellaneous, including Illium, Invar, Kovar, special alloy, tantalum (Cat. 9)

TUBING, Nickel, Monel, Inconel (Cat. 9)

TUBING, Paper (Cat. 9)

TUBING, Plastic (Cat. 9)

TUBING, Plastic Coated Copper & Aluminum (Cat. 9)

TUBING, Precious Metals, including Platinum (Cat. 9)

TUBING, Precision Bore, Glass, see Glass Tubing (Cat. 9)

TUBING, Precision Bore, Metal (Cat. 9)

TUBING, Rubber (Cat.9)

TUBING, Varnished or Lacquered (Cat. 9)

TUBING SUPPORTS, including Cable Supports, Troughs, etc. (Cat. 9)

TUNGSTEN, Wire and Products (Cat. 9)

TURBIDIMETERS (Cat. 4)

TURBINE GOVERNORS (Cat. 1)

TWEEZERS, Instrument —Cat. 9, (see also Tools, Precision—Cat. 9)

ULTRASONIC EQUIPMENT, including Generators (Cat. 3)

ULTRA-VIOLET INDICATORS and/or RECORDERS (Cat. 1)

ULTRA-VIOLET LIGHT SOURCES (Cat. 1)

VACUUM APPARATUS, including Pumps (Cat. 1)

VACUUM CONTROLLERS, INDICATORS, and/or RECORDERS (Cat. 1)

VACUUM GAGES, Hot-Wire, Pirani, etc. (Cat. 4)

VACUUM GAGES, Ionization (Cat. 4)

VACUUM GAGES, McLeod (Cat. 1)

VACUUM GAGES, Molecular (Cat. 4)

VACUUM GAGES, Thermocouple (Cat. 4)

VACUUM, HIGH (below 1 mu) CONTROLLERS, INDICATORS, and RECORDERS (Cat. 1)

VACUUM-OPERATED DEVICES, Electric Motor (Cat. 1)

VACUUM SPECTROGRAPHS, see Spectrographs (Cat. 4)

VACUUM-TUBE BRIDGES, see Bridges (Cat. 3)

VACUUM-TUBE RELAYS, see Relays, Electronc (Cat. 8)

VACUUM TUBE VOLTMETERS (Cat. 3)

VACUUM TUBES, see Tubes, Electron, Vacuum (Cat. 8)

VALVE-OPERATING DEVICES, Electro-pneumatic, see Converters, Electric-to-Pneumatic (Cat. 8)

VALVE OPERATING DEVICES, Hydraulic, including Cylinder (Cat. 1)

VALVE OPERATING DEVICES, Pneumatic, including Cylinder (Cat. 1)

VALVE OPERATING DEVICES, Solenoid (Cat. 1)

VALVE POSITIONERS (Cat. 1)

VALVES, Ball (Cat. 1)

VALVES, Bellows Seal, see Valves, Packless (Cat. 1)

VALVES, Butterfly (Cat. 1)

VALVES, Control (Cat. 1)

VALVES, Diaphragm Seal, including Saunders Patent, Crane, Wynn Type, etc. (Cat. 1)

VALVES, Flexible Sleeve (Cat. 1)

VALVES, Float-operated (Cat. 1)

VALVES, Gage Cocks (Cat. 1)

VALVES, High Pressure (Cat. 1)

VALVES, Needle (Cat. 1)

VALVES, Packless (Cat. 1)

VALVES, Plug (Cat. 1)

VALVES, Pressure Reducing and/or Back-Pressure, see Valves, Control (Cat. 1)

VALVES, Relief and Safety (Cat. 1)

VALVES, Slurry, see Valves, Flexible Sleeve (Cat. 1)

VALVES, Solenoid (Cat. 1)

VARISTORS (Cat. 8)

VARMETERS, see Volt-Ampere Meters, Reactive (Cat. 3)

VEHICLE TRAVEL RECORDERS, see Mileage Indicators (Cat. 7)

VELOCITY INSTRUMENTS, see Speed (Cat. 1)

VENTURI METERS, see Flowmeters, Inferential (Cat. 1)

VENTURI TUBES (Cat. 1)

VIALS, Level (Cat. 8)

VIBRATION INSTRUMENTS, Indicators and/or Recorders (Cat. 1)

VIBRATION ISOLATORS, see Mountings, Shock and Vibration Absorbing (Cat. 8)

VIBRATION PICKUPS (Cat. 1)

VIBRATION TEST EQUIPMENT, including Shake Tables (Cat. 1)

VIBROGRAPHS (Cat. 1)

VIBROMETERS (Cat. 1)

VIBROSCOPES (Cat. 1)

VISCOSIMETER BATHS, Constant-Temperature (Cat. 4)

VISCOSIMETERS, including Brookfield, Engler, Fenske, Ford (for Paint), Hoeppler, MacMichael, Ostwald, Redwood, Scott, Storme, Ubbelohde (Cat. 4)

VISCOSIMETERS, Kinematic (Cat. 4)

VISCOSIMETERS, Recording (Cat. 4)

VISCOSIMETERS, Saybolt (Cat. 4)

VISCOSIMETERS, Ultrasonic (Cat. 4)

VISCOSIMETERS, Zahn (Cat. 4)

VISCOSITY CONTROLLERS, including Consistency (Cat. 1)

VISCOSITY GAGES, see Viscosimeters (Cat. 4)

VISCOSITY TUBES (Cat. 4)

VOLTAGE COMPARATORS (Cat. 3)

VOLTAGE DETECTORS, see Null Detectors (Cat. 3)

VOLTAGE DIVIDERS, see Attenuators, also Potentiometers (Resistors)—Cat. 8

VOLTAGE, HIGH (above 2300 volts) MEASURING DEVICES and/or INDICATORS (Cat. 3)

VOLTAGE REGULATORS, Glow Tube (Cat. 3)

VOLTAGE REGULATORS, Line Voltage (Cat. 3)

VOLTAGE STANDARDS, see Standard Cells (Cat. 8)

VOLTAGE SUPPLIES, see Power Supplies (Cat. 3)

VOLT-AMMETERS (Cat. 3)

VOLT-AMPERE-HOUR METERS (Cat. 3)

VOLT-AMPERE METERS, Reactive (Cat. 3)

VOLTMETERS, AC, Rectifier (Cat. 3)

VOLTMETERS, Digital (Cat. 3)

VOLTMETERS, Electrostatic (Cat. 3)

VOLTMETERS, Indicating and Recoring (Cat. 3)

VOLTMETERS, Laboratory Standard (Cat. 3)

VOLTMETERS, Micro, RF, Millivolts and Microvolts (Cat. 3)

VOLTMETERS, Millivoltmeters, AC, Rectifier (Cat. 3)

VOLTMETERS, Oxide Rectifier (Cat. 3)

VOLTMETERS, Peak (Cat. 3)

VOLTMETERS, Thermo (Cat. 3)

VOLTMETERS, Thermionic Rectifier (Cat. 3)

VOLTMETERS, Vacuum-Tube, see Vacuum-Tube Voltmeters (Cat. 3)

VOLT-OHMMETERS (Cat. 3)

VOLT-OHM-MILLIAMMETERS (Cat. 3)

VOLUME CONTROLS, see Potentiometers (Resistors)—Cat. 8

VSWR INDICATORS (Cat. 3)

WASHERS, Metal & Plastic (Cat. 9)

WASTE TREATMENT INSTRUMENTS (Cat. 1)

WATCHES, Chronometer, including Marine—Cat. 1, (see also Clocks—Cat. 1)

WATCHES, Stop (Cat. 1)

WATCHMAKER'S SUPPLIES and TOOLS (Cat. 9)

WATER ANALYSIS OUTFITS, including Hardness Testers (Cat. 4)

WATER AND SEDIMENT APPARATUS (Cat. 4)

WATER BATHS, Constant Temperature, see Baths (Cat. 4), also Temperature Calibration (Cat. 1)

WATER METERS, see Flowmeters, Positive Displacement (Cat. 1)

WATTHOUR METERS (Cat. 3)

WATTHOUR METER TESTERS (Cat. 3)

WATTMETERS, Clamp Type (Cat. 3)

WATTMETERS, Electrostatic (Cat. 3)

WATTMETERS, Indicating (Cat. 3)

WATTMETERS, Laboratory Standard (Cat. 3)

WATTMETERS, Microwave (Cat. 3)

WATTMETERS, Reactive (Cat. 3)

WATTMETERS, Recording (Cat. 3)

WAVEGUIDES, see Microwave (Cat. 3)

WAVE METERS, see Frequency Indicators (Cat. 3)

WEATHERING MACHINES (Cat. 4)

WEATHERING TESTERS, see Environmental Test Chambers (Cat. 1), also Fading Testers (Cat. 4)

WEIGHT CONTROLLERS, Indicating, Recording (Cat. 1)

WEIGHING BOTTLES (Cat. 4)

WEIGHING SCALES (Cat. 1)

WEIGHING SCALES, Laboratory (Cat. 4)

WEIGHTS, Analytical (Cat. 4)

WEIGHTS & MEASURES, Precision Standard (Cat. 7)

WELDING EQUIPMENT (Cat. 9)

WELLS, Thermocouple or Thermometer, see Thermowells (Cat. 1)

WICKS FOR WET BULBS (Cat. 9)

WIND DIRECTION and VELOCITY INDICATORS and/or RECORDERS, see Meteorological Instruments (Cat. 5)

WIND TUNNEL INSTRUMENTS (Cat. 5)

WIRE, Copper, Enameled (Cat. 9)

WIRE, Covered (Cat. 9)

WIRE, Fuse (Cat. 9)

WIRE, Insulated, all insulations except enameled and refractory (Cat. 9)

WIRE, Magnet (Cat. 9)

WIRE, Metal Shielded (Cat. 9)

WIRE, Miscellaneous, including Bismuth, Columbium, Illium, Molybdenum, special alloy Tantalum (Cat. 9)

WIRE, Nickel, Monel, and Nickel Chromium (Cat. 9)

WIRE, Refractory Insulated (Cat. 9)

WIRE, Resistance (Platinum or Platinum-Iridium)—Cat. 9

WIRE, Resistance, except Platinum and Platinum-Iridium (Cat. 9)

WIRE, Spring (Cat. 9)

WIRE, Stainless Steel, see Wire, Spring (Cat. 9)

WIRE, Swedish, Music, see Wire, Spring (Cat. 9)

WIRE, Thermocouple, Base Metal (Cat. 9)

WIRE, Thermocouple, Rare Metal (Cat. 9)

WIRE MEASURING GAGES, see Dimensional Gages (Cat. 6)

WIRE TESTING MACHINES (Cat. 6)

WIRES and THREAD, Gear Measuring (Cat. 6)

WORMS and WORM GEARING, see Gears, Precision (Cat. 8)

WOW METER (Cat. 3)

WRENCHES, Socket Instrument (Cat. 9)

WRENCHES, Torque (Cat. 9)

XEROGRAPHY EQUIPMENT (Cat. 7)

X-RAY CAMERAS, Diffraction (Cat. 4)

X-RAY EQUIPMENT—Cat. 6, (see also Flaw Detectors—Cat. 6)

X-RAY INTENSITY METERS (Cat. 4)

X-RAY MEASURING INSTRUMENTS (Cat. 4)

X-Y RECORDERS (Cat. 3)

X-RAY VOLTMETERS, High Potential (Cat. 3)

Z-ANGLE METERS, see Impedance Measuring Instruments (Cat. 8)

CATALOG LOCATOR

Catalog 1 starts on page 17
Catalog 2 starts on page 77
Catalog 3 starts on page 87
Catalog 4 starts on page 119
Catalog 5 starts on page 129
Catalog 6 starts on page 133
Catalog 7 starts on page 140
Catalog 8 starts on page 143
Catalog 9 starts on page 185

Compact FISHER P.O.P. that once required *5 basic actuator sizes to cover*

FISHER SERIES 470 P.O.P.

PNEUMATICALLY OPERATED PISTON

Power: Delivers same power in either direction at any point of the stroke.

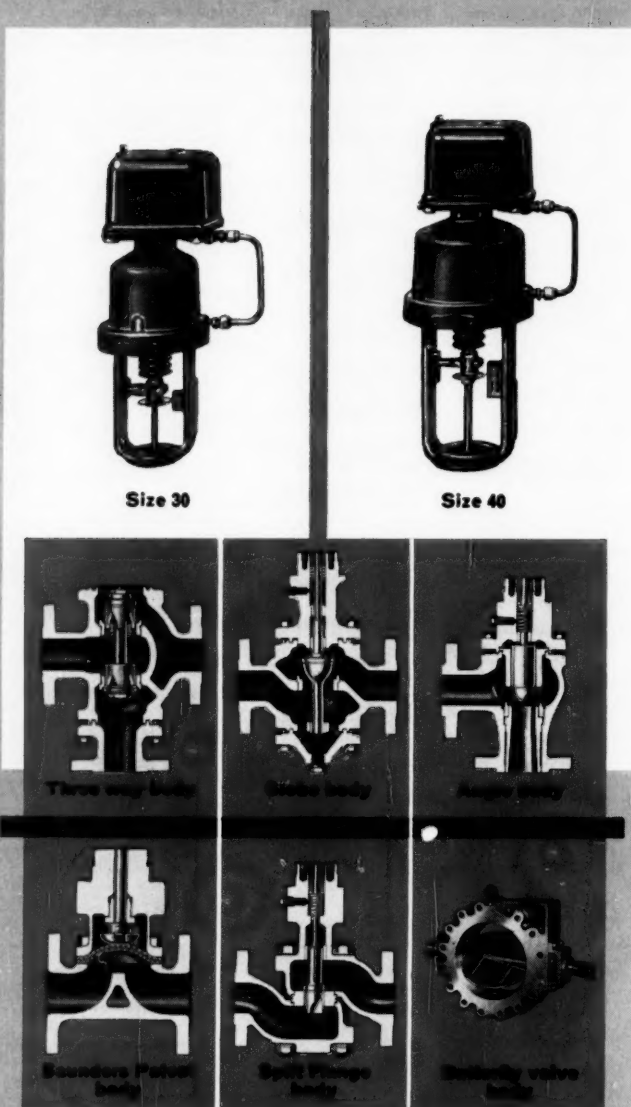
Speed: For example, the size 60 gives you 1.5"/sec. stroking speed.

Accuracy: Max. Hysteresis—0.15% of stroke or signal.

Repeatability—0.03% of stroke or signal.

Resolution Sensitivity—0.02% of instrument pressure range.

Only Fisher gives you this wide selection of actuator-body combinations. This small, compact piston actuator incorporates its own positioner mounted integrally on top of the cylinder. Positioner receives any of the normally used pneumatic instrument signals. Then, without an air set, actuator utilizes the full potential of the available instrument air or gas supply (up to 150 psi) to provide exceptional speed and power. Easily reversible actuator can be changed in the field. Also available in spring return and side mounted handjack models. Send for free booklet E-470.

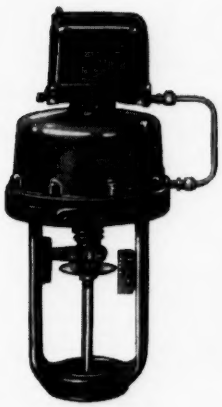


IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

CIRCLE 2 ON READER-SERVICE CARD

actuators handle difficult jobs giant-size equipment

all body styles and sizes



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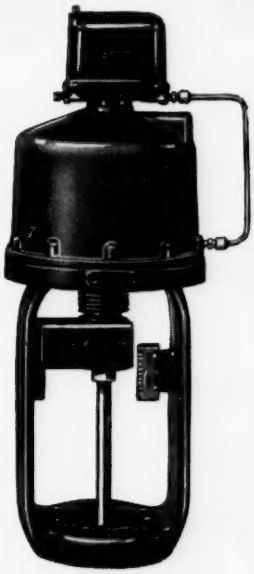

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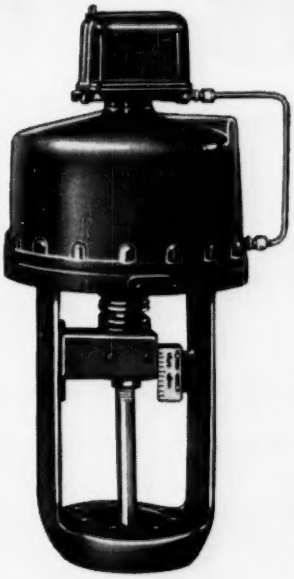
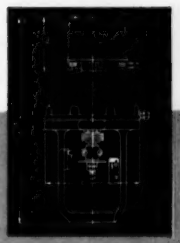


Size 100

SPECIFICATIONS

Actuator Size	Cylinder Size, Inches	Stem Size, Inches	Body Size, Inches	AVAILABLE STEM FORCE		Travel, Inches
				100 PSI Supply	150 PSI Supply	
30	4¾	⅜	½-1½	1500	—	7/16-¾
40	6⅛	½	2-4	2500	—	7/16-1½
43	4¾	½	2-4	1500	2200	7/16-1½
60	8½	¾	5-8	5000	—	7/16-2
63	4¾	¾	5-8	1500	2200	7/16-2
64	6⅛	¾	5-8	2500	3600	7/16-2
80	10¾	1	10-16	8000	—	¾-3
100	13	1¼	10-16	12000	—	¾-3

Note 1. Sizes 43, 63 and 64 may use supply pressure up to 150 psi.



Actuator Size	B Inches	C Inches
30	19¼	6¼
40	21 5/16	8⅛
60	23⅜	10½
80	33 1/16	12¾
100	33 1/16	15

FISHER® Controls SINCE 1880

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT CO., CORAOPOLIS, PENNSYLVANIA

CIRCLE 2 ON READER SERVICE CARD

A Complete Line of Solenoid Valves to answer your Control Problems.

Two-way C Series

A high quality, 2-way, miniature cut-off valve offering top performance at lowest price. Small, lightweight (only 12 oz.) yet designed to operate for millions of cycles in automotive fuel systems, oil burners, vending machines, dental equipment, air horns, welding equipment, humidifiers, automated systems, etc. Available normally closed only.

Two-way L Series

A newly designed high-flow industrial valve for use with all common media such as water, oil, air, etc. Light and compact, it mounts directly to the line. Forged naval brass body, stainless steel parts and fully supported diaphragm assures long life and troublefree operation. Available normally open, normally closed and explosionproof.

Two-way R Series

A 2-way, pilot operated piston valve for use with all common media including air, inert gases, water and oil at standard and high pressures up to 1250 psi. Light and compact, it can be mounted directly to the line in any position and has a life expectancy of millions of cycles on most applications. Available normally closed, normally open and explosionproof.

Two- and Three-way V10 Series

Extremely compact, direct-acting slide type, high pressure hydraulic valve up to 1000 psi. Balanced pressure design provides maximum power. Same valve can serve as either a 2- or 3-way normally open, normally closed or 3-way directional control in machine tools, door openers, hydraulic cylinders, construction equipment, pilot for larger valve, etc.

Two- and Three-way V5 Series

Available in 2- or 3-way and explosionproof construction, this is the most popular and versatile stainless steel valve series. Over 100,000 variations available. Unlimited applications include machine tools, instrumentation, automation, air and hydraulic cylinders, oil burners, LPG equipment, dispensing machines, automotive, aircraft, dehumidifiers, laundry equipment, etc.

Three-way A Series

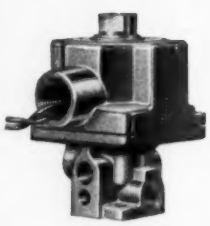
A new valve line designed for economical and efficient operation of medium size cylinders, this valve bridges the gap between the famous V5 line, used with small cylinders, and the reliable M3 line for large cylinders. It also provides faster operation of smaller cylinders where increased cycling speed is called for. It is designed for use with such media as air, oil and inert gases and can be used for vacuums down to 5 microns. Available normally open, normally closed, directional control and multi-directional.

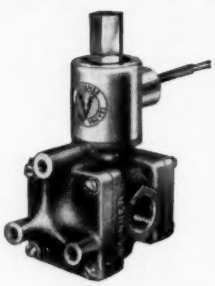
Three-Way M Series

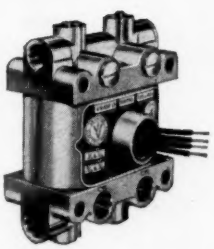
A 3-way valve for reliable high-flow industrial service under rugged conditions of use. Free-flow design provides large capacity with minimum sensitivity to media impurities in air vises, process equipment, presses, water treatment, air and hydraulic cylinders, machine tools, automotive equipment, etc. Available normally open, normally closed, directional control and explosionproof.

Four-way V9 Series

A compact, direct-acting, flexible all-purpose 4-way valve. Optional porting arrangements and speed control combinations provide over 350 basic variations for accurate, dependable control of single and double-acting cylinders, larger pilot-operated valves, etc. Available normally closed — normally closed, normally open — normally open, normally closed — normally open.







Skinner Solenoid Valves are distributed nationally.

See the Yellow Pages for name of representative near you.

THE CREST OF QUALITY

SKINNER ELECTRIC VALVES

THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT

CIRCLE 3 ON READER-SERVICE CARD

Industrial / Process

1960 BUYERS' GUIDE

1

MEASUREMENT AND CONTROL INSTRUMENTATION FOR PROCESS AND MANUFACTURING INDUSTRIES

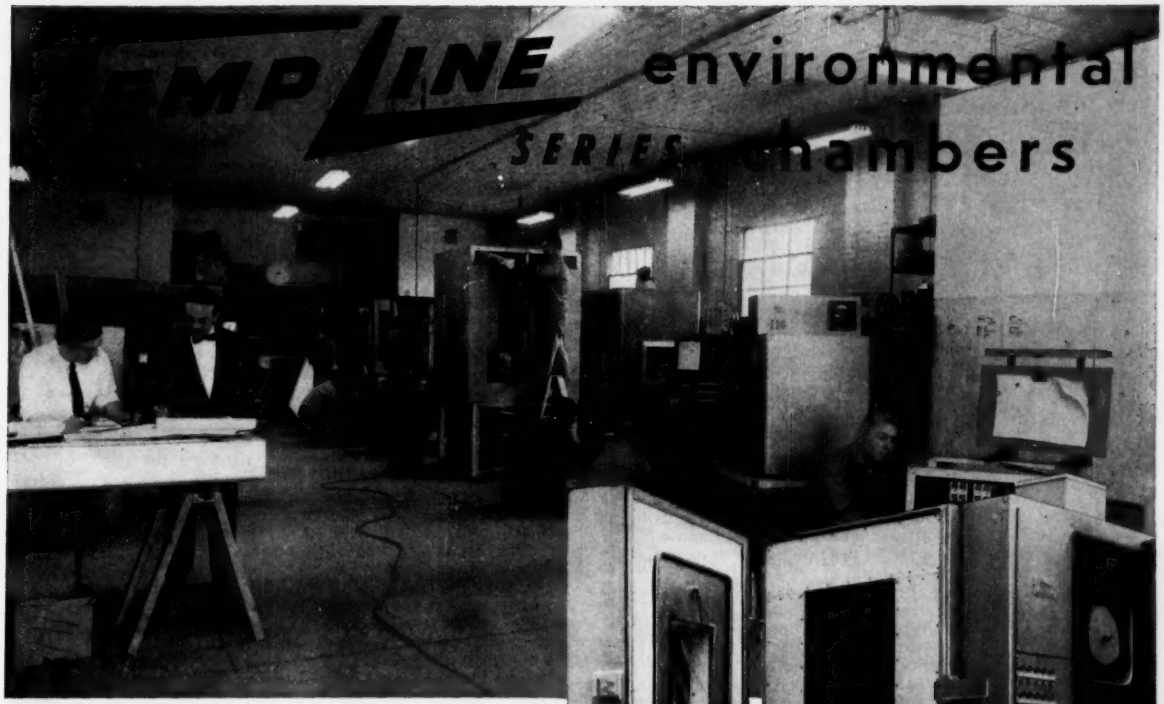
Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters.
No dust filters.
No internal lubrication to contaminate air handled.
No internal wearing parts.
No valves, pistons, or vanes.
Non-pulsating pressure.
Original performance constant over a long pump life.
Low maintenance cost.

NASH ENGINEERING COMPANY
370 WILSON, SO. NORWALK, CONN.



INTRODUCING THE

NEW

TEMPERATURE ALTITUDE HUMIDITY CHAMBER

- Temperature Range —120°F to +500°F
- Altitude Range Sea level to 200,000 feet
- Humidity Range 20% to 95% between +35°F and +200°F, limited by a low dewpoint of +35°F.

STANDARD WORK SPACE SIZES AVAILABLE

- 15" W x 21" H x 12" D
- 24" W x 30" H x 20" D
- 35" W x 36" H x 38" D

OPTIONAL ACCESSORIES AND INSTRUMENTATION AVAILABLE

- Viewing Window
- Interior Light
- Manual Wiper
- Electric Feed-Thru Terminals
- Access Port
- Casters
- Indicating Controllers
- Recording Controllers
- Program Controllers

Also available

LOW TEMPERATURE
HIGH TEMPERATURE
ALTITUDE
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SALT SPRAY
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VACUUM OVENS
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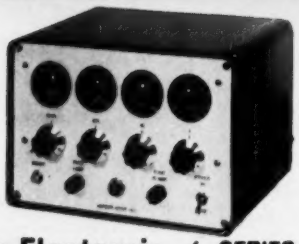
TEMCO INC.
18 BEECHWOOD AVENUE PORT WASHINGTON L I N Y

CIRCLE 4 ON READER-SERVICE CARD

NEW Veeder-Root Counters



New Electronic Predetermining Counters

SERIES 1604

These counters are ideal for batch control, sequential predetermining, or accurate length control in such applications as packaging, coil winding, slitting, stacking and material handling.

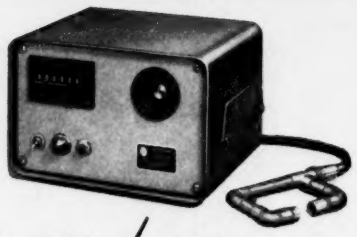
A versatile group of transistorized electronic predetermining counters designed particularly for industrial applications. These units will operate at speeds up to 5,000 counts per second, with automatic recycling at speeds up to 1,000 counts per second. A photohead to actuate the counter can be designed to fit specific applications.

Units can be easily operated by non-technical personnel. The preset quantity can be established quickly at any point within the range of the counter by means of the large selector knobs. Any number of decades can be furnished.

Dual sets of presetting controls for sequential predetermining, or accurate length control in such applications can be furnished on request.

This is your complete package for predetermining counting at high speeds.

For complete details on these units, write today!



Count-PAK

SERIES 1661

Complete electronic counting package for use where high speed, long life and instant reset are required. Highly suitable for high speed direct counting applications such as can and bottle counting or case or piece counting on conveyor lines.

Consists of glow-transfer cold-cathode counting tube and high speed magnetic counter, coupled with transistorized circuits. Photohead designed to your application.

The use of transistors means that heat has been eliminated and no warm up time is required. Unit is completely enclosed in an attractive industrial case to insure long, trouble-free life. Use of an electronic decade increases the life of the electro-mechanical counter and makes the unit ideal for continuous rugged operation.

Write for complete specifications and prices today!

NEW SERIES 1622

High-Speed Predetermining Counter

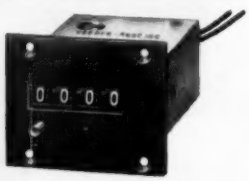
Ideal for high-speed counting requirements such as coil winding, textile spinning frames, and other predetermining counter requirements.

Instant quick-lever reset, plus quick and easy setting of the predetermined number are outstanding features of this counter. Measures approximately 2.6″ wide, 5″ long, 2.8″ high. Speeds up to 6,000 RPM or 8,000 CPM are maximums recommended.

Easily preset to the required number of pieces or performance-units, the counter subtracts to zero. Resetting returns wheels to original preset number. This new counter meets standard U. S. electrical requirements (JIC Codes) . . . and is available with either electrical switch or mechanical stop. Also available without the predetermining feature, as a high speed reset revolution counter.

Also available as a high-speed revolution counter without predetermining feature.

Write for complete information today!



SERIES 1591

Electro-Magnetic Counter

These new compact panel-mounted high speed counters are ideal for D.C. applications requiring accuracy, long life at high speeds and small panel presentation. Counters are suitable for industrial data processing, laboratory and scientific or instrument applications. Available with four or six figures with remote electrical or manual (push button) reset. 3,000 counts per minute recommended speed.

Counters can be connected in series with any device having a contact arrangement. For optimum operation, 60% contact time is required.

Panel Area: 4-figure Counter — 1.7″ x 2.1″
6-figure Counter — 1.7″ x 2.8″

Available for 6, 12, 24, 48 and 115 volts D.C. operation. For A.C. operation suitable electrical components must be added externally. Reset voltages available are 6, 12, 24, 48, 115 and 230.

Write for complete specifications today!

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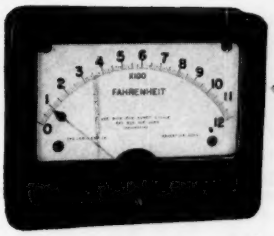
CIRCLE 5 ON READER-SERVICE CARD

LEWIS

AUTOMOTIVE AND INDUSTRIAL TEMPERATURE MEASURING EQUIPMENT

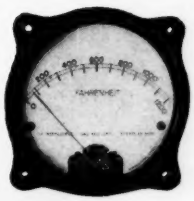
Sturdy Dependable Indicators —Suitable For Use In Moving Vehicles or For Permanent Installation

This instrument has been used extensively by the leading motor-car manufacturers for road testing on the "Proving Grounds" — where performance counts. Housed in a rectangular bakelite case, this reliable, fully compensated pyrometer is furnished with 6 in. hand drawn scales for greater accuracy. The Model 58PY is available for use with all standard thermocouple materials, in many ranges to suit the most exacting application.



MODEL 58PY

Manufactured with the same type of movement as our aircraft pyrometers, the Model 23B pyrometer is well suited for use in moving vehicles and has been successfully used in many marine diesel installations for measuring exhaust temperatures. It is housed in a 4 in. round bakelite case that is flanged for panel mounting, and is available in several ranges for use with various thermocouple materials.



MODEL 23B

The Model 20B series of indicators are patterned after our standard aircraft instruments and are supplied with 3" round steel cases suitable for panel installation. These compact, sturdy indicators have 2⅛ in. scales, are fully cold-end compensated and are available in many ranges for use with various thermocouple materials.

MODEL 20B

The Model 62RT4F resistance thermometer is a sturdy easy-to-read instrument with a 6 in. hand drawn scale. It is suitable for use in moving vehicles and is excellent for flight-test work. It is operated by an ordinary dry cell and is calibrated to standard "AN" bulb curves for various ranges in fahrenheit or centigrade.

MODEL 62RT4

THERMOCOUPLES for use with the above indicators are available in many styles for special applications. We have developed a complete line of aircraft, industrial and automotive thermocouples and would be pleased to offer our recommendation for your application.

THERMOCOUPLE LEAD WIRE for connecting thermocouples to the indicators is manufactured in iron-constantan, copper-constantan or chromel-alumel material with standard and special insulation. Use Lewis lead-wire with Lewis instruments and thermocouples for best results.

RESISTANCE BULBS for use as sensing elements for the 62RT4 thermometers are available in several types for various applications, for measuring free air or liquid temperatures. We invite inquiries on your application.

THE LEWIS ENGINEERING CO.

Specialists in Electrical Temperature Measurements

NAUGATUCK, CONNECTICUT

CIRCLE 6 ON READER-SERVICE CARD

Alnor® FOR PRECISE MEASUREMENT OF

TEMPERATURE...
AIR VELOCITY...
DEW POINT...

PYROMETERS

A complete line of single or multiple-point pyrometers—portable or mounted—for temperature measurement in all types of service. Particularly adapted to exhaust, cooling water and lubricating oil temperature measurements on diesel and gas engines. For furnaces, kilns, ovens, vats, pots, heat exchangers, kettles, reactors, autoclaves, pipe lines and any similar equipment where accurate temperatures are desired.

PYROCON

A self-contained, hand-held portable contact pyrometer. Takes any surface temperature. Widely used in plastic molding, chemical processing, electrical, rubber and paper manufacturing industries. Available with fixed or flexible arm.

VELOMETERS

An instantaneous air velocity meter giving direct readings in feet per minute without necessity of timing, calculation, or reference to tables or charts. A compact, self-contained, portable unit. For low range readings, Velometer is held in air stream. For high range readings, tube-connected special jets provide convenient use in any location. Standard ranges from 20 f.p.m. to 24,000 f.p.m.

DEWPOINTERS

An improved instrument for simple, rapid dew point reading of any gas. Indication takes place in an enclosed observation chamber under accurately controlled conditions. Dew or fog suspended in air—not on mirrored surface—makes it easy for two or more observers to get the same accurate results. The Alnor Dewpointer is a complete, self-contained unit—no external coolants or other apparatus are required.

SURFACE PYROMETER

The Alnor type 2300 Pyrometer sets a new high in precision measurement of low surface temperatures. Special design, from Alnico magnet to the finest, quick reacting thermocouple, assures unfailing accuracy . . . speed and dependability. This is a self-contained, sturdy unit—easily carried and used anywhere on a wide variety of applications. Direct reading, six-inch mirrored scale is easily read . . . quickly understood. The instrument is available in five Fahrenheit scale ranges with a span as small as 150°.

PORTABLE PYROMETER

The Alnor type 1500 is designed for work with electrically heated mantles. This lightweight, magnetically shielded pyrometer gives fast, precise temperature reading to production men in all industries. Choice of ten scale ranges, 0-400° to 0-3000°F. Automatic cold end compensator is standard equipment.

Alnor®

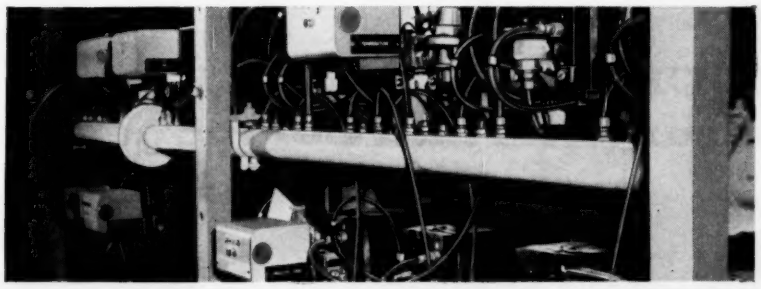
ILLINOIS TESTING LABORATORIES, INC.
Room 537, 420 N. LaSalle St. • Chicago 10, Illinois

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

CIRCLE 7 ON READER-SERVICE CARD

IMPERIAL Engineering and Data File

ENGINEERED TUBE FITTINGS — VALVES — TUBING TOOLS



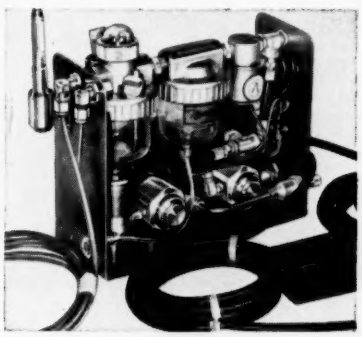
How Poly-Flo tube fittings cut installation costs, save space, eliminate bending

IMPERIAL'S Poly-Flo Fitting and Tubing now offer creative engineers a practical, low-cost solution to a wide range of tough jobs. The following case histories demonstrate typical Imperial product savings:

PROBLEM No. 1: High installation cost. Copper tubing cost $2.10 per ft. to install on an instrument panel for one Eastern Chemical plant. Further, chemical corrosion created high replacement costs.

SOLUTION No. 1: For an identical panel where polyethylene tubing and Poly-Flo Fittings were used, labor costs were slashed to 14½¢ a foot . . . a savings of 93%. Poly-Flo Tubing is also impervious to most chemicals, creating extra savings.

Sensational savings in time and labor — as with this documented example — are typical when you choose Poly-Flo. Remember, you need only a pocket knife to cut the tubing to exact length.

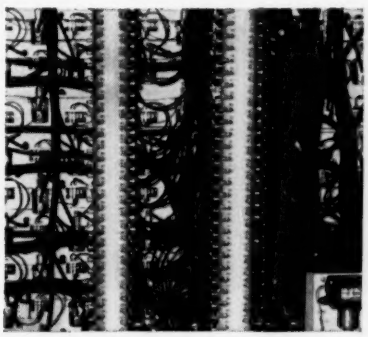


PROBLEM No. 2: Limited work space was encountered in assembling this dental equipment, designed by Aero Turbex. This equipment operates at speeds in excess of 250,000 rpm.

SOLUTION No. 2: Poly-Flo Tubing and Fittings beat this problem because no wrenches are needed for installation. Nut is just finger tightened, providing a connection that withstands the burst pressure of the Poly-Flo Tubing—from 250 to 600 psi.

Even in extremely close quarters **if you can reach the area with your fingers, you can make a foolproof connection.**

Tubing can be used in a temperature range from −90° to +175° F. Also, Poly-Flo is non-toxic, odorless and tasteless, an important consideration on food and medical equipment.



PROBLEM No. 3: Elimination of Tube Bending. Shown above is a Pressure Comparator Cabinet for an automatic data logging system. Because hundreds of tube bends were needed to complete the job, metal tubing costs were unduly high.

SOLUTION No. 3: Poly-Flo is so flexible, no time is wasted bending the tubing to fit. Tubing bends readily by hand. No special tools, either.

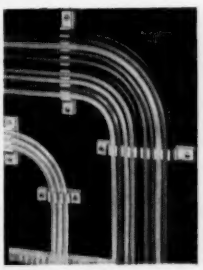
This tubing is ideal for smallest areas, too. For example, ¼" Poly-Flo tubing can be bent a full 360° to form a ⅞" radius circle *with no apparent constriction or collapsing of tube walls.*

Tubing is available in nine colors — color coding quickly identifies circuits. Sizes of tubing are: ¼" O.D., .040" wall; 5/16" O.D., .062" wall; ⅜" O.D., .062" wall; and ½" O.D., .062" wall.

CIRCLE 8 ON READER-SERVICE CARD

Plastic Tube Rack Speeds Poly-Flo Tubing Installations

Holds from 1 to 10 plastic or metal tubes. Rack is especially convenient for holding bends in Polyethylene, Nylon and other plastic tubing. For use on panels, instrument boards and other installations where a number of tubes are involved. Cuts installation time — assures a neater appearance.



Rack can be cut quickly with a knife. Furnished in natural color Polyethylene.

Write for Engineering File No. 3025.

Fluid Control Valves for Every Application

Whenever you have an application calling for fluid control valves — check on Imperial's complete, quality line. Whether the job calls for needle valves, toggle valves, 2-, 3-, or 4-way plug valves or diaphragm valves, Imperial can provide the right valve to meet your requirements.

Write for Catalog No. 200.

THE IMPERIAL BRASS MFG. CO.

Dept. ICS-109, 6300 W. Howard St., Chicago 48, Ill.

In Canada: 18 Hook Ave., Toronto, Ontario

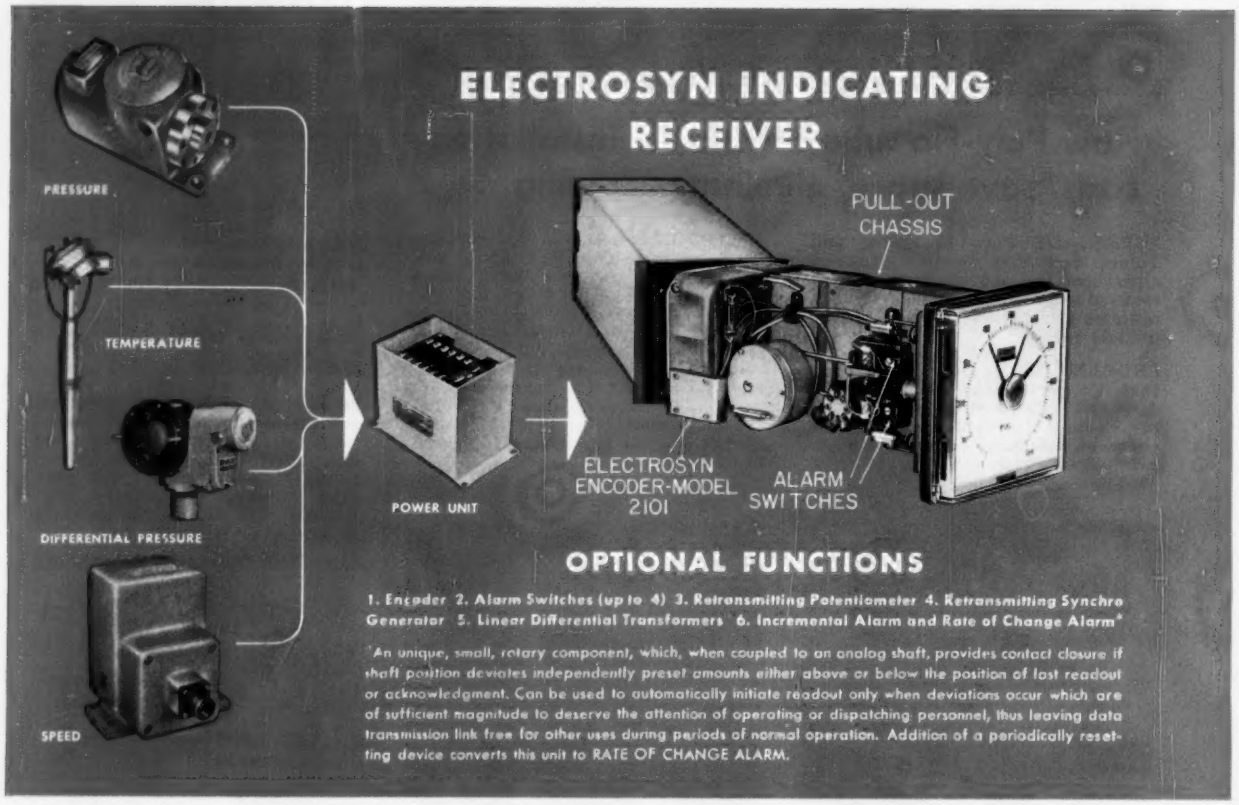
IMPERIAL

FIRST NAME IN FLUID TRANSMISSION COMPONENTS

HIGH RELIABILITY
LOW MAINTENANCE

NORWOOD CONTROLS

PROCESS and TELEMETRY Instruments and Components


ELECTROSYN INDICATING RECEIVER
PULL-OUT CHASSIS
PRESSURE
TEMPERATURE
DIFFERENTIAL PRESSURE
SPEED
POWER UNIT
ELECTROSYN ENCODER-MODEL 2101
ALARM SWITCHES
OPTIONAL FUNCTIONS
1. Encoder 2. Alarm Switches (up to 4) 3. Retransmitting Potentiometer 4. Retransmitting Synchro Generator 5. Linear Differential Transformers* 6. Incremental Alarm and Rate of Change Alarm*
*An unique, small, rotary component, which, when coupled to an analog shaft, provides contact closure if shaft position deviates independently preset amounts either above or below the position of last readout or acknowledgment. Can be used to automatically initiate readout only when deviations occur which are of sufficient magnitude to deserve the attention of operating or dispatching personnel, thus leaving data transmission link free for other uses during periods of normal operation. Addition of a periodically resetting device converts this unit to RATE OF CHANGE ALARM.

Norwood Controls' ElectroSyn is a highly flexible, rugged electro-magnetic system for a wide range of applications in the chemical processing, atomic power, natural gas and petroleum transmission fields. It is designed to measure, indicate, record (including analog to digital conversions), or control a wide range of process variables. (Pressure, differential pressure, flow, level, temperature.)

Error signal is amplified by a magnetic servo-amplifier (which can be located up to 4 miles from transmitter). Signal voltage is compared with output from a servo-motor driven feedback ElectroSyn Signal Generator. Pointer on indicator turns until signal and feedback balance and then entire system ceases to move until next transducer signal change.

Also available as alternate systems: transistorized servo-indicator which performs same functions as magnetic amplifier system (illustrated above) and a low-cost meter readout system for either pressure or differential pressure when only indication of the variable is required.

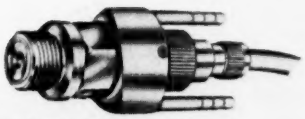
These three systems offer a price range in keeping with the economics of most any application.

Write for ElectroSyn Bulletin B258C

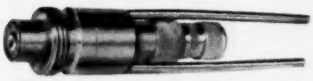
NORWOOD CONTROLS

STRAIN GAGE

PRESSURE TRANSDUCERS



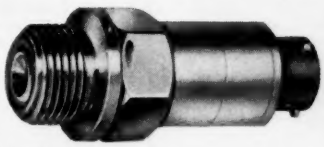
Models 108, 109 and 110



Model 113

WATER COOLED PRESSURE TRANSDUCERS

Models 108, 109, 110 and 113 water-cooled, high frequency transducers for pressure studies under very high temperatures. Can be exposed to gas temperatures above 5000 F without damage. All-welded construction for any applications, including highly corrosive liquids and propellants. Ranges: 0-500, 0-1000, 0-2000, 0-3000 and 0-5000 psi.



Model 111A

AIRBORNE PRESSURE TRANSDUCER

Specially constructed unit with features designed for high altitude flight service applications, such as 1000 volt insulation of electrical components for proper performance with vacuum ambient.

Model 201

PRESSURE MONITOR

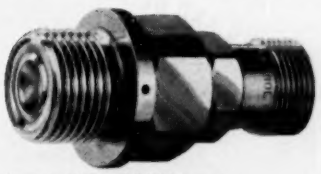
Amplifies 2-arm transducer output signal for oscilloscope display. Internal, manually-operated calibration provisions included, or may be equipped with external Model 203 Automatic Calibrator. Write for Technical Data Sheet A159-5.

- High frequency response: flat from 0-20,000 cps.
- Bonded strain gage (rugged, low inertia, high stiffness) sensing element.
- Adaptable to virtually all strain gage amplification and readout equipment.
- Widest range of any pressure transducers on the market: ranges 0-25 to 0-100,000 psi.
- Widest temperature range: 0-250 F with air-cooled transducers (0-500 F with Plastics Transducers); 0-5000 F with water-cooled transducers.
- For both dynamic and static measurements without special equipment (which is required with crystal-type transducers). Ideal for internal combustion and rocket engine studies and pressure measurements in various high temperature processes, including plastic extrusion.
- Silver soldered or, for corrosive applications, all-welded cotenary diaphragms.
- Insensitive to humidity (unlike crystal-type transducers).
- 2-arm 4-pin and 2-arm 3-pin bridges.
- 350 ohm 4-arm 4-pin standard and compensated bridges.
- Comprehensive, prompt repair service at minimum cost — no longer must you consider transducers expendable.
- High output signal.
- Custom designs for special requirements.

Model 175

PLASTICS PRESSURE TRANSDUCER

New, one-piece, flush diaphragm, bonded strain gage type of pressure transducer, suitable for use in plastics extruders and other equipment where process temperatures approach 800 F and cooling of process fluid is not permissible. Standardized dimensions for extruder mounting.



Models 101 and 102 (2-arm), 111 and 112 (4-arm)

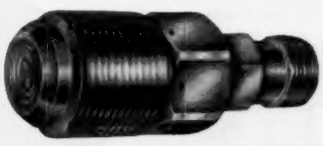
STANDARD PRESSURE TRANSDUCERS

Highly accurate, versatile transducers for dynamic pressure measurements requiring high frequency response (flat from 0-20,000 cps). Ranges from 0-100 up to 15,000 psi.

Model 103

MINIATURIZED PRESSURE TRANSDUCERS

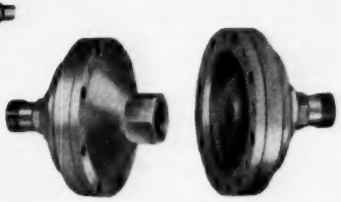
Miniaturized unit designed for applications where small size is a prime requisite. St'd threads 10-1.0 mm or ⅜"-24 are provided. High frequency response flat from 0-20,000 cps. Ranges: 1,000, 2,000, 3,000, 5,000 and 7,000 psi.



Model 104

HIGH PRESSURE TRANSDUCERS

For high pressure applications in blast analyses, gun barrel pressures, hydraulic high pressures, etc. Frequency response; flat from 0-20,000 cps. Ranges from 0-20,000 to 0-100,000 psi.



Model 105 **Model 106**

LOW PRESSURE TRANSDUCERS

For pressure ranges 0-25 and 0-50 psig. Utilize same strain tube assembly as models above. May be used under conditions of extreme vibration as encountered in measuring shock waves in open air.

For detailed specifications write for Data Sheets A259 and A158-1:
Norwood Controls Unit, Detroit Controls Division, 5900 Trumbull Avenue, Detroit 8, Mich.

AMERICAN-Standard PRODUCTS

AMERICAN-Standard

DETROIT CONTROLS DIVISION

CIRCLE 9 ON READER-SERVICE CARD

For All ELECTRONIC SYSTEMS, APPLICATIONS: AIRBORNE or GROUND-BASED

the A. W. HAYDON COMPANY

offers a complete line of

TIMING DEVICES

ALTERNATING AND DIRECT CURRENT

Tough & Tiny Sub-Miniatures
Rugged & Reliable Electronics
Time-Proven Electro-mechanicals

PRECISION TIMING MOTORS

Repeat Cycle Timers
Time Delay Relays
Stop Clocks
Intervalometers
Coding Devices

ELECTRO MECHANICAL AND ELECTRONIC TIMING DEVICES

REPEAT CYCLE TIMERS

— 3" long (Typical)
— 6½ ounces basic
— 1-8 switches (Standard)
— Cycle Time 5 sec to 90 Min.
— Loads to 5 Amperes

Write for Bulletin AWH RC-301

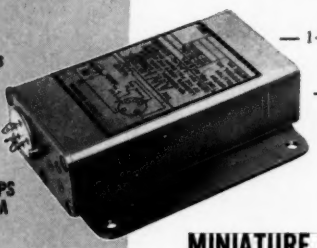
SUB-MINIATURE ELECTRO-MECHANICAL TIMING DEVICES

Features
Hermetically Sealed Housings
¼ Size
— ½ Weight of Standard Designs
1 x 2 Cross-Section
DC, 60 or 400 CPS
Meet MIL-E-5272A

TIME DELAY RELAYS

— 3" long (Typical)
— 7½ ounces basic
— 1-3 switches (Standard)
— Time Delays
— 25 Sec. to 3 Hours
— Loads to 5 Amperes

Write for Bulletin AWH TD-502



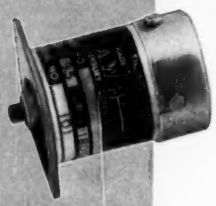
ELAPSED TIME INDICATORS

— Sub-Miniature — Hermetically Sealed
— 1¼" Diameter — 2⅛" Long (max.)
— 3 Watts maximum power
— Digital or Dial Type
— 60 cps & 400 cps models cataloged
— DC Models Available
— Meet MIL-E-5272A MIL-M-7793B

Write for Bulletin
AWH ET-602 describes 400 cps models
AWH ET-603 describes 60 cps models

MINIATURE TIMING MOTORS

— Compact — High Performance
— 60 or 400 Cycle AC
— 15/16" Diameter — 1 7/32" long
— Direct Current
— 13/16" Diameter — 1 11/32" long
— Submit problem statement with motor requirements for recommendations



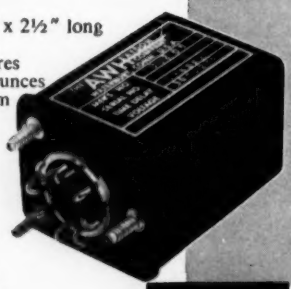
ELECTRONIC TIME DELAY RELAYS

Features
Hermetically Sealed Housings
Variety of Circuits
Temperature to 250°F
Vibration to 2000 cps, 15 g
Meet MIL-E-5272A
Unique Transistorized RC Time Constant network
Time Delays 50 MS to 120 sec.

Miniature Series

— 1 7/16" x 1 21/32" x 2½" long
— 1-4 SPDT contacts
— Loads to 10 Amperes
— Weight — only 6 ounces
— 5½ Watts maximum power

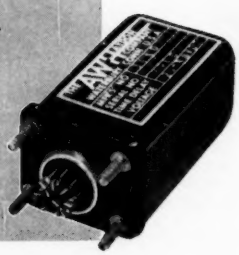
Write for Bulletin AWH TD-503



Sub-Miniature Series

— 31/32" x 1 3/16" x 2" long (max.)
— 1-2 SPDT contacts
— Loads to 8 Amperes
— Weight only 3 ounces
— 4 Watts maximum power

Write for Bulletin AWH TD-504



ALSO AVAILABLE

A Complete Line of timing devices and instruments for Military, Commercial & Industrial Applications.
Write for specific literature or complete catalog.

The **A.W. HAYDON *Company***

224 NORTH ELM STREET, WATERBURY 20, CONNECTICUT

CUSTOM DESIGN & MANUFACTURE OF ELECTRONIC AND ELECTRO-MECHANICAL TIMING DEVICES

CIRCLE 10 ON READER-SERVICE CARD

PALMER a great name in thermometers

PALMER "DIRECT DRIVE" 3½" DIAL THERMOMETER

An outstanding improvement in mercury actuated dial thermometers with external calibration feature.

- No Sector
- No Pinion
- No Linkage
- Accuracy
- Readability
- Angularity

Case . . . stainless steel, compensated for ambient temperature, external calibrating feature. Cover . . . clear plastic, gasket-sealed to stainless steel back-plate. Actuation . . . direct drive Bourdon coil. (No sector, pinion or linkage.) Stem . . . ½" diameter stainless steel, standard lengths: 4"—6"—8"—12", multiples of 6" up to 60" max. . . . Fittings . . . separable socket, union connection (½" or ¾" NPT), flange union.

PALMER 4½" DIAL THERMOMETER

Adaptable and interchangeable with all Industrial Thermometer applications.

MERCURY-ACTUATED. Guaranteed accuracy. Size: 4½" Dial.

Designed for use as STRAIGHT or any ANGLE. With clear vision all-glass moulded case and metal back. Fittings: Plain, Union, Socket; adjustable or union Flanges.

STANDARD RANGES:

−30+130°F. 1°	0+300°F. 2°	0+600°F. 5°
0+150°F. 1°	0+400°F. 5°	+200+750°F. 5°
0+240°F. 2°	0+500°F. 5°	+200+950°F. 5°

or equivalent °C—no extra charge

RECORDING and DIAL THERMOMETERS

With Flexible Tubing Connection.

Mercury-actuated, for extreme accuracy. Sturdy construction, very sensitive. All parts rust-proof. Stainless-steel bulb. Wall or Flush Mounting. Bottom or Back connection. Fittings: Plain, Union, Sep. socket; Adj. or Union Flanges.

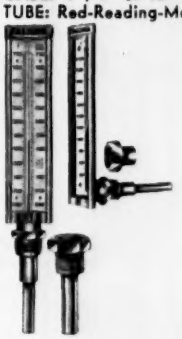
Ranges: —40 to 1000°F. (or C).

RECORDER: 12" die-cast alum. case; Black or white, satin or wrinkle finish; elec. or spring clock; 12 hr., 24 hr., or 7-day charts. One-pen or multiple pens. Also Fully compensated to correct for Ambient Temperature.

DIAL: 6" and 8" round case. Black or white finish. Easy-reading dial.

INDUSTRIAL THERMOMETERS with "Red-Reading-Mercury"

CASE: 7", 9" or 12" Extruded brass. Wide scale. Chrome finish.
TUBE: Red-Reading-Mercury Easy to Read. Thoroughly annealed for permanent accuracy. Protected by double-strength glass shield. Graduated scale.



Straight

FITTINGS: Fixed thrd., Union, Sep. Socket; adjustable or union Flange; parallel thrd. & locknut; special fttgs. to order.

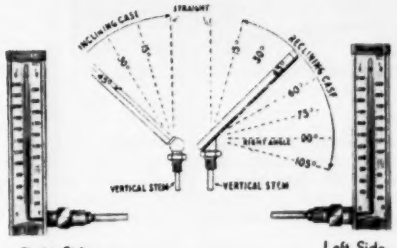
STEM: STRAIGHT and Misc. ANGLES. 3½" to 60", incl. thread.

THREAD: ¾" or 1" NPT (½" not recom.)

STANDARD RANGES:

−40+110°F	2°	+ 50+400°F	5°
0+100°F	1°	+100+550°F	5°
+30+180°F	2°	+200+750°F	5°
+30+240°F	2°	+200+950°F	5°
+30+300°F	2°		

Plain Mercury. Borosilicate tube. Centrigrade equiv.—no extra. Spec. Ranges—cost more.



Right Side

Left Side

SMALL CASE THERMOMETERS

4" case ⅜" & ½" Fixed Thrd. Fttg.
6" case: ½" & ¾" Sep. Socket Fttg.
Extruded case. Durable Nickel finish.
"Red-Reading-Mercury". Guaranteed accurate.

LABORATORY AND PRECISION THERMOMETERS

All glass engraved mercury tube, with vivid RED column. Round or lens; Ring or button top; With or without metal armor; Total or partial Immersion (3" standard). Each in sep. box. All ranges: up to 750°F. (or C. equiv.).
Plain mercury. Borosilicate tube. +200+950°F.
Special ranges & dimensions to order. Fractional division, A.S.T.M. etc.
Also handy 5" Pocket style. Annealed and guaranteed very accurate.

REPAIRS—To all makes of mercury Industrial Thermometers. With "Red-Reading-Mercury" (no extra cost) and new Extruded Brass case included. Guaranteed accurate. Reasonable price.

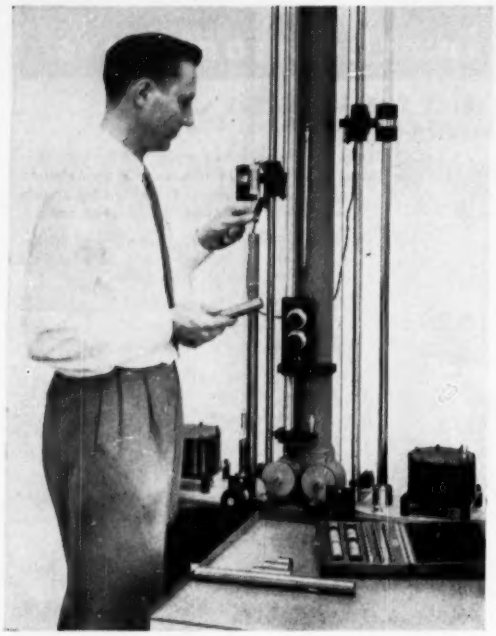
PALMER THERMOMETERS, INC.

Mfrs. of Industrial Laboratory, Recording and Dial Thermometers

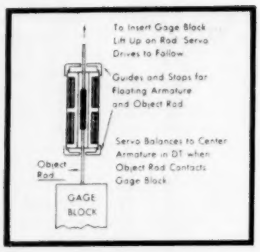
2518 NORWOOD AVE., CINCINNATI 12, O.

CANADIAN PLANT: PALMER THERMOMETER LTD., TORONTO. 2

CIRCLE 11 ON READER-SERVICE CARD



Exactel Servomanometers emphasize calibration proving provisions in precision pressure measurement

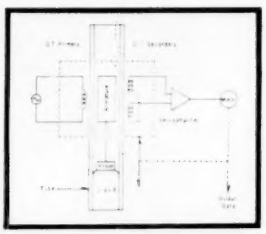

To Insert Gage Block Lift Up on Rod. Servo Drives to Follow
Guides and Stops for Floating Armature and Object Rod
Servo Balances to Center Armature in DT when Object Rod Contacts Gage Block
Object Rod
GAGE BLOCK

Several years of experience and a great deal of statistical data have now been accumulated on the use and reliability of Exactel's verifying techniques. Customers have been able to prove accuracies of one part in 20 to 50 thousand. For example, three 120 inch range Servomanometers, and a fourth operating as a standard, were recently calibrated in parallel with maximum deviation of 0.004". The calibration proving facilities established the absolute accuracy of the values within this limit.

Exactel instruments may be supplied with three basic provisions for checking and proving of calibrations. The combination of techniques provides a true primary standard wherein the calibration is based upon as well as proved by cgs standards.

The calibration proving provisions, available singly or in total, permit verification of the mechanical accuracy of the follower and readout mechanism, ability of the instrument to read true liquid column height and determination of error in temperature compensation. The methods are described in Exactel Bulletin 500.

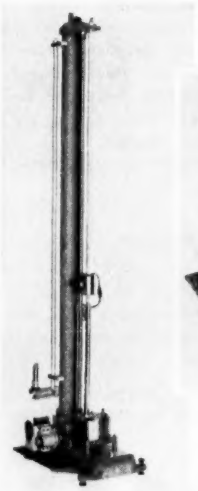
Mechanical accuracy, for example, is proved by the following technique: A second differential transformer mounted on the carriage is equipped with an armature mounted on an "object rod" that is free to float vertically except as guided and restrained by Nylon end bushings. The DT has a connector that may be plugged into the line that ordinarily goes to the DT that senses the float. When the calibration proof DT is used, the servo drives in a direction tending to center the armature when the bottom of the object rod contacts a solid object, normally the base of the instrument serving as a reference surface or the top of a Jo block. Thus by installing Jo blocks and allowing the servo to balance, the overall mechanism may be easily calibrated in a matter of minutes. The height of the stack of Jo blocks is read on the counter (with the inclusion of correction for cistern drop at a known ratio). This particular proving facility, originally offered as an optional feature, has proved so reliable and popular it is now being included as standard equipment.

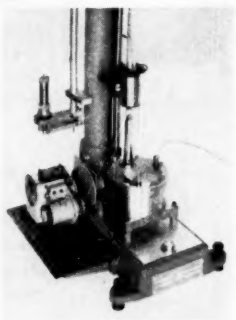


The basic Exactel principle.

A differential transformer (DT) is continuously positioned by a servo to be electrically centered about a float containing magnetic material. A proportional shaft position in the servo transmission is then analogous to the position of the liquid column.

Illustrated at right is uncabineted Model 560IN-D with Analog Temperature Compensation, calibration proving provision, synchro output, counter and area for mounting auxiliary readout and control devices. The lower end of the tube passes through the top of the cistern and terminates beneath the manometer liquid. This constuction is virtually leakproof, provides improved liquid column response, permits removal of the tube without draining instruments, avoids pockets of trapped air that can compress under pressure and offers several other operating advantages. This is one of 38 standard models available in single or dual instrument construction. Many optional features are available, including use of stainless steel manometer tubes and high pressure construction, choice of any liquid and variations in calibration units and servo characteristics.





"Servomanometer" and "Analog Temperature Compensation" are trade names of Exactel Instrument Company.

EXACTEL INSTRUMENT COMPANY
185 Evelyn Avenue • Mountain View, California
YOrkshire 8-6558

CIRCLE 12 ON READER-SERVICE CARD

JOHNSON PNEUMATIC CONTROL

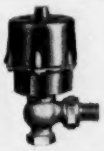
For Processing • Heating • Cooling Humidifying • Dehumidifying Ventilating • Air Conditioning

PROCESS CONTROL. Automatic temperature and humidity control for a wide range of manufacturing and industrial process applications. Thermostats, special controllers, valves and dampers applied to tanks, dryers, vats, kettles, curing rooms, coolers, kilns, ovens and other processing equipment.

SPACE CONTROL. Automatic control of room temperature and humidities applied to radiators, radiant heating, unit ventilators, unit heaters and heat delivery ducts. Johnson equipment includes a complete line of thermostats, thermometers, pressure regulators, humidostats, humidifiers, valves, dampers, damper operators, switches, special controllers and related apparatus.

NATIONWIDE SERVICE. Johnson's own full time engineers and installation men are available at branch offices across the nation. Whether your problem involves a complete system or merely a single controller, take advantage of Johnson's over 73 years' experience in solving all types of control problems.

DIAPHRAGM VALVES FOR STEAM AND LIQUIDS



V-153 Sylphon Diaphragm Valve for low pressure steam. Sizes ½" and ¾". *Send for Bulletin V-153.*

V-103 N.O. Globe Valve. ½" to 8" sizes. *Send for Bulletin V-103.*

3-Way Valves for mixing and by-pass applications. 100% tight-closing design. Can be serviced without removal from line. Sizes 2½" to 6". 125 and 250 lb. standard construction. *Send for Bulletins V-211 (By-Pass) and V-214 (Mixing).*

V-111 Sylphon Radiator Valve for low pressure steam. Sizes ½" to 2". *Send for Bulletin V-111.*

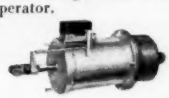
MASTER-SUBMASTER CONTROL FOR STEAM, LIQUIDS OR AIR

T-900 Remote Bulb Master Thermostat. *Send for Bulletin T-900.*

T-901 Remote Bulb Submaster Thermostat. *Send for Bulletin T-901.*

PISTON OPERATORS, PILOT POSITIONERS

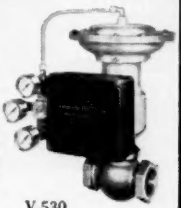
D-251 Long-Stroke Piston Operator.



Pilot Positioner Applied to Piston Damper Operator.

Piston Operators for dampers and similar uses. Compact with fully enclosed spring and rubber diaphragm. Adjustable stops. Available with pilot positioner for applications requiring maximum and precise repositioning power. *Send for Bulletins D-251 and D-265.*

V-530 Precision Pilot Positioner. Powerful, precise! Responds to slightest change in air pressure. Acts 6 times faster than ordinary pilots. Consumes no more air than a room thermostat. *Send for Bulletin V-530.*



V-530 Precision Pilot Positioner applied to valve.

RECORDING AND INDICATING CONTROLLERS FOR TEMPERATURE, PRESSURE, HUMIDITY

T-1000 Record-O-Stat. Records and controls. Built for extreme accuracy under all conditions. Single and two-pen models. Liquid-filled, vapor tension or gas-filled thermal systems. For ranges between minus 125 F and plus 1000 F. Charts for 24 hours or 7 days. *Send for Bulletin T-1000.*

R-1051 Static Pressure Indicator-Controller. Controls at a pressure range as low as 0 to 0.2 in. of water. Extremely accurate for either static or differential pressure control. *Send for Bulletin R-1051.*

THERMOSTATS

T-403 Single Temperature Room Thermostat. *Send for Bulletin T-403.*

T-432 Heating-Cooling Room Thermostat. *Send for Bulletin T-432.*

Series T-800 Thermostats for steam, liquids or air. Proportional or two-position action. Furnished with remote bulb for liquids or air; rigid stem models for insertion or immersion. Separable sockets available. *Send for Bulletin T-800*

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

JOHNSON SERVICE COMPANY

507-PP East Michigan Street, Milwaukee 1, Wisconsin

Please send me the following free Product Bulletins:

☐ V-153 ☐ V-211 ☐ V-111 ☐ T-901 ☐ D-265 ☐ T-1000 ☐ T-403 ☐ T-800
☐ V-103 ☐ V-214 ☐ T-900 ☐ D-251 ☐ V-530 ☐ R-1051 ☐ T-432

☐ *New Condensed Catalog of all Johnson Products.*

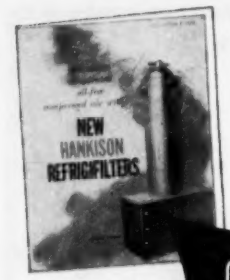
Name_____

Firm_____

Address_____

City & State_____

CIRCLE 13 ON READER-SERVICE CARD



Bul. F-100
Where cooling water is not available

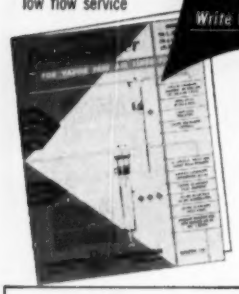
Bul. 4158
Integrated filter, dehydrator, separator, trap

Bul. 103
For dead end and low flow service

Bul. 501C
Efficient, automatic condensate discharge

CLEAN UP YOUR INSTRUMENT AIR SUPPLY

Write for these bulletins!



Hankison COLLEGE & PIKE CANONSBURG, PA.

CIRCLE 14 ON READER-SERVICE CARD

AIR CLEANERS, Instrument
Adams Co R P
Air Maze Corp
Conoflow
Gas Drying Inc
Gelman Instrument
Hankison Corp
Kahn & Co
Kieley & Mueller
Phoenix Precision Instr
Pittsburgh Lectrodryer
Radex Corp
Robbins Aviation Inc
Selas Corp of America
Trinity Equipment

AIR COMPRESSORS, Instrument
Air-Shields Inc
Chemiquip
Johnson Service Co
Kahn & Co
Leiman Bros Inc
Nash Engineering
Penna Pump & Compressor
Sterling Precision

BEARING TEMPERATURE INSTRUMENTS, including Alarm
Aero Research Instr
Assembly Products Inc
Atkins Technical Inc
Burling Instrument
Edison Industries T A
Electro Devices (Mo)
Fenwal Inc
Foxboro Company
GE Apparatus Sales Div
Gilmore Industries
Illinois Testing Labs
Leeds & Northrup
M-H Brown Instrs Div
Moeller Instr
Murphy Mfg Inc
Nanmac Corp
Panellit Inc
Pyrometer Instr Co
Royco Instruments Inc
Thermo Electric
United Electric Controls
Victory Engrg Corp
Weksler Instruments
West Instrument
Weston Instruments
Westronics Inc
Winslow Company Inc

BOILER ROOM INSTRUMENTS, including Condenser Leakage, Damper, Desuperheat, Draft, Feedwater, Specialties, Steam, Stoker, etc. (see also Combustion Safeguards, also Gas Analyzers)
Bacharach Indus Instr
Bin-Dicator Co

BAILEY MULTI-POINTER GAGE UNIT

• Provides two large, easily-read 7-inch vertical gages in space only 4 inches wide. Multi-Pointer Gage Units may: (1) measure and indicate draft, pressure, differential pressure, and level; (2) transmit these variables either pneumatically or electrically to remote indicators, recorders, and/or controllers; or (3) receive and indicate any measured variables which may be transmitted pneumatically by standard SAMA ranges of 3-15 psig or 3-27 psig.

Any number of basic two-indicator units may be placed side-by-side to provide indications of related factors. Each two-indicator unit is separately mounted.

Standard ranges from 0-0.5 in. H_2O to 0-5000 psig are available.

Request Product Specifications M42-2.

BAILEY METER COMPANY
1041 IVANHOE ROAD CLEVELAND, O.
Bailey Meter Company Ltd. Montreal, Canada

CIRCLE 17 ON READER-SERVICE CARD

BAILEY BOILER METER

Steam Flow—Air Flow Ratio Meter

• This dependable and accurate guide to maximum combustion economy is easily understood and followed by operators. It indicates, records, and integrates Steam Flow from the boiler, records Air Flow supplied for combustion, and records Flue Gas Temperature.

Best combustion efficiency is secured by keeping the Steam Flow and Air Flow pens together so that the records coincide. The record of the Flue Gas Temperature when compared with that of Steam Flow shows the condition of baffles and tubes, and indicates heat absorption efficiency.

The **Bailey Boiler Meter** reduces fuel costs, lessens maintenance and outage, lowers standby costs, and adds capacity. It is suitable for boilers of 100 hp or more and for all types of fuels.

To obtain maximum benefit from the **Bailey Boiler Meter,** it should be made an integral part of a Bailey Combustion Control System so that combustion losses are automatically corrected as they tend to appear.

Request Product Specification M61-1.

BAILEY METER COMPANY
1041 IVANHOE ROAD CLEVELAND, O.
Bailey Meter Company Ltd. Montreal, Canada

CIRCLE 15 ON READER-SERVICE CARD

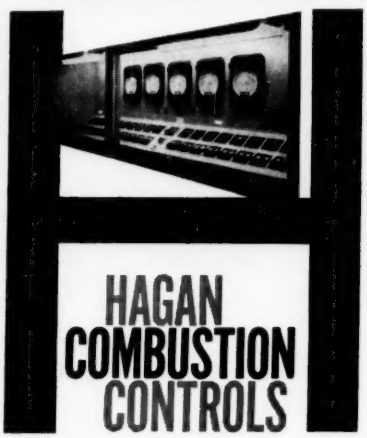
BOILER ROOM INSTRUMENTS

- Electrolytic conductivity apparatus for steam and condensate degassing.
- Boiler Feedwater measurements.
- A complete line of recording instruments available in line and battery powered models.
- Salinity detecting and controlling equipment.
- Condenser leakage detectors.

Write for complete catalog

Industrial Instruments Inc.
84 Commerce Road, Cedar Grove, Essex County, N. J.

CIRCLE 16 ON READER-SERVICE CARD



HAGAN COMBUSTION CONTROLS

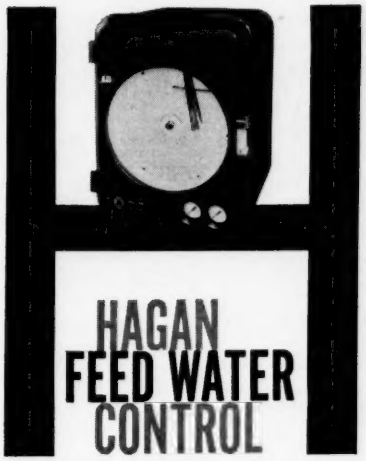
Hagan pneumatic or solid state electronic combustion control systems give the ultimate in accurate, dependable control. Hagan systems include basic combustion control, 3-element feedwater control, pump recirculation control and steam temperature control.

Hagan systems, on both central station and industrial boilers, have established records for economy, reliability and very low maintenance costs.

HAGAN CHEMICALS & CONTROLS, INC.
DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

CIRCLE 18 ON READER-SERVICE CARD



The Hagan system of 3-element feed water control is compensated for variations in fluid density, a feature not available in most systems.

In addition, the system is automatically compensated for discrepancies between steam generated and steam measured. This means drum level is held at set point, even during blowdown or steam soot-blowing.

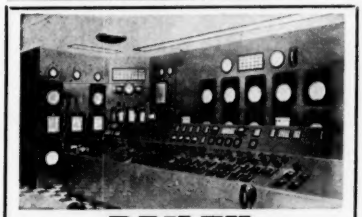
HAGAN CHEMICALS & CONTROLS, INC.

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.

In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

CIRCLE 19 ON READER-SERVICE CARD



BAILEY *Combustion* CONTROL

● Bailey Automatic Combustion Control results in substantial savings in fuel; increased boiler capacity; reduction of boiler and furnace maintenance; more time for operators to devote to general station maintenance; and improvement in the general character of service.

Bailey Automatic Combustion Control makes possible the every day operation of boilers at test efficiencies, because it is a COMPLETE combustion control system which: (1) automatically maintains steam pressure by supplying fuel and air simultaneously to boilers in accordance with changes in steam demand; (2) automatically maintains most economical fuel-air ratio by incorporating the **Bailey Boiler Meter** as an integral part of the system; (3) automatically maintains the desired furnace draft; and (4) automatically distributes load among boilers so that each unit carries its share.

This sturdy, inexpensive, air-operated control system has been applied to all sizes and types of boilers ranging from 200 hp upward. It is applicable to all fuels and all methods of firing.

Request Bulletin 515 and Bulletin 1023.

BAILEY METER COMPANY

1041 IVANHOE ROAD · CLEVELAND, O.

Bailey Meter Company Ltd. Montreal, Canada

CIRCLE 20 ON READER-SERVICE CARD

Exactel Instrument
Magnetrol Inc
Bailey Co Chas M
Bailey Meter Co
Barber-Colman
Chemiquip
Defender Instrument
Diamond Power Specialty
Ellison Draft Gage
GPE Controls
General Controls
Hagan Chem & Controls
Hays Corporation
Industrial Instruments
Leeds & Northrup
Mason Neilan
McDonnell & Miller
Meriam Instr Co
Mine Safety Appliances
M-H Rubicon Instrs Div
North American Mfg
Photomation Inc
Powers Regulator
Pyrometer Instr Co
Ranarex Div
Reliance Instr Mfg
Thermoo Instrument
Uehling Instrument
Victory Engrg Corp
Warrick Co Chas F
Weksler Instruments
Weston Instruments
Westronics Inc

B.T.U. INDICATORS

Air Conditioning Equip
American Meter Co
Bailey Meter Co
Foxboro Company
Hagan Chem & Controls
Hays Corporation
Westronics Inc

CHEMICAL FEEDERS, Dry and Liquid

American Meter Co
B-I-F Industries
Clark-Cooper
Exline Engrg
Fischer & Porter Co
Fuller Co
Gump Co B F
Hills-McGanna
Lapp Insulator
Loe Engrg Co
Milton Roy Co
Natl Instrument Co
Research Appliance Co
Richardson Scale Co
Syntron Co
Thayer Scale Corp
Wallace & Tiernan
Weighing & Control Comps

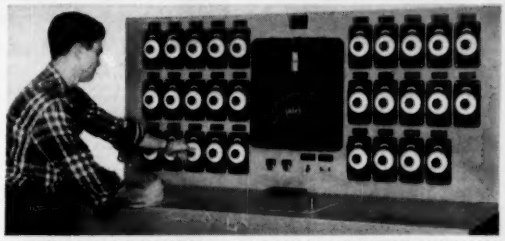
CLOCKS, Master or Primary

Alina Corp
American Electronics Inc
American Meter Co
Cincinnati Time Recorder
Edwards Co Inc
Electro Instruments
General Radio
Hamilton Watch Co
Natl Time & Signal
Standard Electric Time
Stromberg Time Corp
Times Facsimile

CLOCKS, Minute Impulse and Synchronous

Alina Corp
Anadex Instruments Inc
Chrono-Log Corp
Cincinnati Time Recorder
Cramer Controls
Edwards Co Inc
Electro Instruments
General Controls
Haydon Instrument
Micronics Div
Natl Time & Signal
Parabam Inc
Photocon Research
Standard Electric Time
Stromberg Time Corp
Sunshine Scientific
Thompson Clock Co
Times Facsimile
United Electrodynamics
Wang Laboratories

CONTROL SYSTEMS

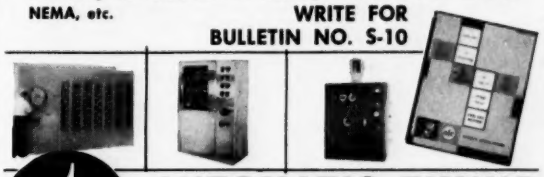


ELECTRONIC • PNEUMATIC • HYDRAULIC • ELECTRO-MECHANICAL

To realize economy, efficiency and higher plant profits, management is looking more and more to correctly applied automatic control.

Backed by years of research and field experience, ATC is uniquely equipped to help you in the design and manufacture of complete control systems for machines and processes. Full familiarity for execution to industry standards such as JIC, NEMA, etc.

WRITE FOR BULLETIN NO. S-10



AUTOMATIC TIMING & CONTROLS, INC.

KING OF PRUSSIA, PENNA.

A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

CIRCLE 21 ON READER-SERVICE CARD

CLOCKS, Secondary

Alina Corp
Cincinnati Time Recorder
Edwards Co Inc
Geotechnical Corp
Hamilton Watch Co
Micronics Div
Natl Time & Signal
P I C Design Corp
Standard Electric Time
Stromberg Time Corp

CLOCKS, Standard

Alina Corp
Cincinnati Time Recorder
Edwards Co Inc
General Radio
Geotechnical Corp
Hamilton Watch Co
Hewlett-Packard
Natl Time & Signal
Research Controls
Rockwell Mfg Co
Standard Electric Time
Stromberg Time Corp

CLOCKS, Stop

Alina Corp
Burke & James
Cramer Controls
Ducommun Co M
Hamilton Watch Co
Haydon Co A W
Micronics Div
Standard Electric Time
Thompson Clock Co

COMBUSTION CONTROL EQUIPMENT (see also Boiler Room Instruments)

Automatic Switch Co
Bailey Meter Co
Cash Co A W
Defender Instrument
Diamond Power Specialty
Eclipse Fuel Engrg
Ellison Draft Gage
Foxboro Company
General Controls
General Regulator
GPE Controls
Hagan Chem & Controls
Hays Corporation
Kieley & Mueller
Leeds & Northrup
North American Mfg
Partlow Corp
Photomation Inc
Pyrometer Instr Co
Ranarex Div
Reliance Instr Mfg
Selas Corp of America
Victory Engrg Corp
Weston Instruments
Westronics Inc
Worner Electronic Devices

COMBUSTION SAFE-GUARDS, including Flame Failure

Bailey Meter Co
Barber-Colman
Crump Instrument
Dage Television
Diamond Power Specialty
Dietz Co Henry G
Eclipse Fuel Engrg
Edison Industries T A
Energy Kontrols
Falcon Alarm Co
General Controls
General Regulator
McIlvaine O T
Partlow Corp
Photomation Inc
Ranarex Div
Reliance Instr Mfg
Selas Corp of America

CONSISTENCY REGULATORS, Pulp and Paper

Brabender Instr C W
Cash Valve Mfg
Curtiss Wright
Dezurik Corp

Automatic Controllers

Bristol Controllers are made in a wide variety of models including air-operated, electronic, and electric types.

Five kinds of control action: on-off, proportional, reset, derivative, and reset plus derivative, also autoset and cascade controllers, ratio controllers, pneumatic transmission, miniature instruments, program controllers, electronic potentiometers. For temperatures up to 4000F, pressure, absolute pressure, vacuum, draft, liquid level, flow, pH, humidity, time cycle and program, and control panels.

Write for Bulletins A130, DM050, A115, B226, and C305.

500 Controller Series

BRISTOL COMPANY

112 Bristol Rd., Waterbury 20, Conn.

CIRCLE 22 ON READER-SERVICE CARD

HAGAN POWRMAG CONTROLS

For all types of process control systems, Hagan PowrMag (magnetic amplifier) analog computer control offers high stability, simplified construction and compatibility with data processing equipment.

- All solid state—no tubes or transistors.
- Interchangeable plug-in modular elements—no stocking problems.
- Rate, proportional band, reset action—all other computer functions built-in.
- Space saving panel stations—easy to maintain.

HAGAN CHEMICALS & CONTROLS, INC.

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

CIRCLE 23 ON READER-SERVICE CARD

Fischer & Porter Co
General Regulator

CONTROL SYSTEMS, General-purpose, Air-operated

American Meter Co
Astra Technical Instr
Automatic Timing & Contls
B-I-F Industries
Bailey Co Chas M
Bailey Meter Co
Berneo Engrg Corp
Black, Sivalls & Bryson
Bristol Co
Brooks Rotameter
Cash Co A W
Cash Valve Mfg
Chemiquip
Conoflow
Control Panel Corp
Designers For Industry
Fisher Governor
Foxboro Company
Fulton Sylphon Div
General Regulator
Hagan Chem & Controls
Industrial Engrg Corp
Johnson Service Co
Kieley & Mueller
Leslie Co
Mason Neilan
Mercoid Corp
M-H Brown Instr Div
Moore Products Co
Panellit Inc
Partlow Corp
Phoenix Precision Instr
Pneu-Hydro Valve
Powers Regulator
Ramsey Engrg Co
Reeves Pulley Co
Research Controls
Scientific Instrument
Specialties Inc
Tapco Group
Taylor Instrument
United Aircraft Prods
United Electric Controls
U S Electrical Motors
Universal Match
Weston Instruments

CONTROL SYSTEMS, General-purpose, Electrical or Electronic

Abrams Instrument
Advanced Research
Airborne Accessories
Airpax Electronics
Allen-Bradley
American Data Div
Amer Meas & Control
Anadex Instrument Inc
Analogue Controls Inc
Appalachian Electronic
Applied Science Corp
Assembly Products Inc
Astra Technical Instr
Automatic Electric
Automatic Switch Co
Automatic Timing & Contls
B-I-F Industries
Bailey Meter Co
Baldwin-Lima-Hamilton
Barber-Colman
Bendix Montrose Div
Berkeley Dynamics
Berneo Engrg Corp
Bin-Dicator Co
Blue M Electric
Bristol Co
Brooks Rotameter
Bulova Research
Burroughs Corp
Bush Associates G F
B/W Controllers
Cargill Detroit
Cash Valve Mfg
Cincinnati Time Recorder
Clark Controller
Computer Measurements
Conoflow
Consol Electrodynamics
Consolidated Systems
Control Panel Corp
Control Technology
Controls Co of Amer
Corbett Science Labs
Crump Instrument
Cunningham Son & Co
Curtiss-Wright IMI
Dalmotor Div
Datex Corp
Defender Instrument
Designers For Industry
Designs For Tomorrow
Detroit Controls
Devco Engrg Inc
Diamond Power Specialty
Dl/An Controls
DJECO
Donner Scientific
Dynapar Corp
Dynatronics Inc
Eagle Signal
Edison Industries T A
Electric Eye Equip
Electric Regulator
Electro Instruments
Electro Precision
Electro Products Labs
Electronic Associates
Electrosnap
Ellison Draft Gage
Energy Kontrols
Engelhard Industries
Epsco Inc
Fairfield Engrg
Femco Inc
Fenwal Inc
Ferranti Electric
Fischer & Porter Co
Fisher Governor
Foxboro Company
Fuller Co
GPE Controls
General Devices
GE Apparatus Sales Div
GE Specialty Controls
GE X-Ray Dept
General Railway Signal
General Regulator
Genesys Corp
Gulton Industries
Hagan Chem & Controls
Haledy Electronics
Haydon Co A W
Hays Corporation
Healy-Ruff Co
Heller Co Gerald K
Hermes Electronics
Houston Instrument
Hughes Products
Hydel Inc
Industrial Engrg Corp
Industrial Nucleonics
Johnson Service Co
Kahn & Co
Kavamil Co
Kearfott Co
Larson Instrument
Leach Corporation
Leeds & Northrup
Librascope Inc
Link Aviation
Machinery Electrification
MacLaren & Co F B
Magnavox Co
Manning Maxwell & Moore
McIlvaine O T
Mercoid Corp
Micro Gee Products
Microloc Corp
Milgo Electronic
M-H Aeronautical Div
M-H Brown Instrs Div
Missouri Res Labs
Moore Associates
North Electric Co
Norwood Controls
Optimized Devices
Panellit Inc
Partlow Corp
Peschel Electronics
Photobell Co
Photomation Inc
Post Electronics
Potter Instr Co
Ram Meter Inc
Ramsey Engrg Co
Ransom Research
Reeves Instr Corp
Regent Controls
Reliance Instr Mfg
Research Inc
Revere Corp of Amer
Scientific Instrument
Servo Systems Co
Simmonds Aerocessories
Southwestern Indus El.X
Specialties Inc
Spectra Electronics
Sterling Precision
Stromberg Time Corp
Sunshine Scientific
Swartwout Co
Tapco Group
Taylor Instrument
Technitrol Engrg
Telechrome Mfg Corp
Teller Co
Texas Instruments Inc
Thermo Electric
Thermo Electric Mfg
Thomas Engrg Inc
Thompson-Ramo-Wooldridge
Triner Scale & Mfg
Tri-Tronics Co
Trott Electronics
United Aircraft Prods
United Control Corp
United Electric Controls
United Engineers Inc
U S Electrical Motors
Universal Match
Uniwave Inc
Vectrol Engrg
Vickers Electric Prods Div
Victory Engrg Corp
Virginia Electronics
Wang Laboratories
Warrick Co Chas F
Waukesha Motor Co
West Instrument
Westinghouse Director Sys
Westinghouse Electric
Weston Instruments
Westronics Inc
Worner Electronic Devices

CONTROL SYSTEMS, General-purpose, Electromechanical

Abrams Instrument
Advanced Research
Airborne Accessories
American Data Div
Amer Meas & Control
Analogue Controls Inc
Applied Science Corp
Assembly Products Inc
Astra Technical Instr
Automatic Electric
Automatic Timing & Contls
B-I-F Industries
Bailey Co Chas M
Baldwin-Lima-Hamilton
Berkeley Dynamics
Berneo Engrg Corp
Bin-Dicator Co
Brabender Instr C W
Breeze Corporations
Bristol Co
Bulova Research
Burroughs Corp
Bush Associates G F
Cargill Detroit
Cash Co A W
Cash Valve Mfg
Cincinnati Time Recorder
Conoflow
Consol Electrodynamics
Consolidated Systems
Control Technology
Controls Co of Amer
Control Panel Corp
Corbett Science Labs
Cunningham Son & Co
Curtiss-Wright I M I
Dalmotor Div
Datex Corp
Daytronic Corp
Defender Instrument
Designers for Industry
Designs for Tomorrow
Devco Engrg Inc
Dickson Co
Dynatronics Inc
Eagle Signal
Eastern Industries
Edison Industries T A
Electric Eye Equip
Electric Regulator
Electro Development
Electro Products Labs
Electrosnap
Energy Kontrols
Farmer Electric
Ferguson Hille
Fischer & Porter Co
Fuller Co
Fulton Sylphon Div
GPE Controls
General Devices
GE Apparatus Sales Div
General Regulator
Genesys Corp
Gulton Industries
Hagan Chem & Controls
Haydon Co A W
Hays Corporation
Healy-Ruff Co
Houston Instrument
Humphrey Inc
Hydel Inc
Hydromatics Inc
Industrial Engrg Corp
Industrial Nucleonics
Inseo Company
Kahn & Co
Kavamil Co
Kearfott Co
Leeds & Northrup
Librascope Inc
Linear Controls
Link Aviation
MacLaren & Co F B
McIlvaine O T
Micro Gee Products
Microloc Corp
Micrometrical Mfg
Milgo Electronic
M-H Aeronautical Div
M-H Brown Instrs Div
Muirhead Instrs Inc
Murphy Mfg Inc
North Atlantic Indus
North Electric Co
Norwood Controls
Panellit Inc
Parabam Inc
Partlow Corp
Philco Corp
Phoenix Precision Instr
Pneu-Hydro Valve
Precision Mechanisms Corp
Ram Meter Inc
Ramsey Engrg Co
Reeves Instr Corp
Rotary Devices Corp
Sciaky Bros Inc
Specialties Inc
Spectra Electronics
Sunshine Scientific
Tapco Group
Taylor Instrument
Technitrol Engrg
Telechrome Mfg Corp
Tel-Instrument Elx
Texas Instruments Inc
Thermo Electric
Triner Scale & Mfg
United Aircraft Prods
United Electric Controls
Universal Match
Uniwave Inc
Vickers Electric Prods Div
Wang Laboratories
Warner & Swasey Co
Waukesha Motor Co
Weston Instruments
Westronics Inc

COUNTERS, Alarm

Airpax Electronics
Automatic Timing & Contls
Beckman/Berkeley Div
Berkeley Dynamics
Bulova Research
Chrono-Log Corp
Durant Mfg
Fischer & Porter Co
General Controls
Genesys Corp
Nuclear Materials & Eqpt
Philco Corp
Photobell Co
Presin Co
Richardson Scale Co
Tech Measurement Corp

COUNTERS, Electronic, including events-per-unit-time

Airpax Electronics
Allegany Instrument
American Electronics Inc
Analogue Controls Inc
Appalachian Electronic
Baird-Atomic Inc
Beckman/Berkeley Div
Bendix Cincinnati Div
Berkeley Dynamics
Bowmar Instrument
Bulova Research
Burroughs Corp
Canadian Marconi
Computer Equipment
Davenport Mfg
Dl/An Controls
Digitran Co
Dymec Inc
Dynapar Corp
Dynatronics Inc
Eberline Instrument
Electronic Computer Co
Electro Precision
Engineered Electronics
Erie Pacific
Erie Resistor
Exline Engrg
Fischer & Porter Co
Freed Transformer
General Controls
General Devices
GE Heavy Mil Elx Dept
General Time Control
Genesys Corp
Hamner Electronics
Haydon Co A W
Hewlett-Packard
Instruments Inc
Landis & Gyr
Lavole Labs
Link Aviation
Machinery Electrification
Mast Development
Milgo Electronic
Navigation Computer Corp
Northeastern Engrg
Nuclear-Chicago
Nuclear Elx Corp
Performance Measurements
Philco Corp
Photobell Co
Photocon Research
Photomation Inc
Potter Instr Co
Redford Corp
Standard Electric Time
Sciaky Bros Inc
Standard Instrument
Stelma Inc
Sterling Precision
Sunshine Scientific
Systron Corp
Tech Measurement Corp
Telechrome Mfg Corp
Trott Electronics
Universal Match
Uniwave Inc
Veeder-Root Inc
Walkirt Co

COUNTERS, Footage

Abrams Instrument
American Electronics
Automatic Timing & Contls
Beckman/Berkeley Div
Camera Equipt Co
Designers for Industry
Ducommun Co M
Durant Mfg
Dynapar Corp
Electric Tachometer
Freed Transformer
General Controls
Gurley W & L E
Machinery Electrification
Mast Development
M-H Davies Labs Div
Presin Co
Redford Corp
Stevens Mfg George
Veeder-Root Inc

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COUNTING TUBES FOR RELIABLE, HIGH SPEED COUNTING APPLICATIONS

Baird-Atomic uses DEKATRON glow transfer tubes in all instruments where counting and read-out are required. A typical application is the Atomic Instrument Line's Model 134 Scaler for ultra-high speed counting of beta and gamma radioactivity . . . up to 1,000,000 counts/minute! The input circuit incorporates a fast, constant-sensitivity Schmitt discriminator driving a beam switching decade with glow tube read-out . . . 6 DEKATRONS.

You too, can count on DEKATRON for reliable performance. For detailed information request Data Sheet IC 4001.

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Baird Atomic

Instrumentation for Better Analysis

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COUNTERS, Mechanical, including Stroke
Acromark Co
American Data Div
American Electronics Inc
Borg Equipment Div
Bowmar Instrument
Bulova Research
Digitran Co
Durant Mfg
Electric Tachometer
Empire State Labs
Fischer & Porter Co
General Controls
General Devices
Haydon Instrument
Landis & Gyr
Mast Development
North Electric Co
Presin Co
Richardson Scale Co
Royson Engrg Co
Tejax Engrg Corp
Veeder-Root Inc

COUNTERS, Predetermined, including Batch
Abrams Instrument
American Electronics Inc
Automatic Electric
Automatic Timing & Contls
Beckman/Berkeley Div
Berkeley Dynamics
Beva Laboratory
Bowmar Instrument
Bowser Inc
C & K Components
Di/An Controls
Digitran Co
Durant Mfg
Dymec Inc
Dynapar Corp
Eagle Signal
Electro Precision
Fischer & Porter Co
Foxboro Company
Freed Transformer
Engineered Electronics
Erie Pacific
Erie Resistor
General Controls
Gilmore Industries
Instruments Inc
Landis & Gyr
Machinery Electrification
Mast Development
Photobell Co
Photocon Research
Post Electronics
Potter Instr Co
Presin Co
Ram Meter Inc
Ransom Research
Redford Corp
Richardson Scale Co
Scisky Bros Inc
Standard Instrument
Stevens Mfg George
Systron Corp
Trott Electronics
Veeder-Root Inc
Walkirt Co

COUNTERS, Revolution
Airpax Electronics
Amerac Inc
American Data Div
American Electronics Inc
Automatic Timing & Contls
Beckman/Berkeley Div
Berkeley Dynamics
Bowmar Instrument
Burroughs Corp
Datex Corp
Digitran Co
Durant Mfg
Eagle Signal
Eastern Specialty Co
Electric Tachometer
Electro Products Labs
Epic Inc
Erie Resistor
Fischer & Porter Co
Foxboro Company
Freed Transformer
General Controls
Gurley W & L E
Haydon Instrument
Hewlett-Packard
Mast Development
North Electric Co
Richardson Scale Co.
Presin Co
Service Recorder
Standard Electric Time
Stevens Mfg George
Streeter Amet
Uniwave Inc
Veeder-Root Inc
Walkirt Co

COUNTERS, Vehicular
American Data Div
American Electronics Inc
Engler Instr
Fischer & Porter Co
Ram Meter Inc
Streeter Amet

CURVE FOLLOWERS (See also X-Y Recorders—Cat. 3)
Curtiss Wright
Electronic Associates
Exactel Instrument
Geotechnical Corp
Gilmore Industries
Houston Instrument
Librascope Inc
M-H Brown Instrs Div
Research Inc
Sanborn Company

DENSITY CONTROLLERS
Air Conditioning Equip
Automation Products
Barton Instrument
Brooks Rotameter
Curtiss Wright
Fischer & Porter Co
Foxboro Company
Hagan Chem & Controls
Hallikainen Instrs
Industrial Nucleonics
Kieley & Mueller
M-H Brown Instrs Div
Nuclear-Chicago
Nuclear Elx Corp
Nuclear Materials & Eqpt
Ohmart Corp
Photobell Co
Poole Instrs Inc
Precision Thermometer
Ramsey Engrg Co
Reliance Instr Mfg
United Engineers Inc
Weston Instruments

DISPLACEMENT INDICATORS, and/or RECORDERS, Angular and Non-Linear and Motion
Automatic Timing & Contls
Brush Instruments Div
Daytronic Corp
Dickson Co
Electro Products Labs
General Radio
Gurley W & L E
Houston Instrument
Instrol Inc
Luther Mfg Co
Micro Gee Products
Micrometrical Mfg
M-H Brown Instrs Div
Norwood Controls
Photocon Research
Sanborn Company
Specialties Inc
Sterling Precision
Vinson Mfg Co
Westronics Inc

DISPLACEMENT INDICATORS and/or RECORDERS, Linear Motion
Aeronaut & Instr Div
Automatic Timing & Contls
Brush Instruments Div
Daytronic Corp
Electro Products Labs
Ferranti Electric
Foxboro Company
General Radio
Gurley W & L E
Instrol Inc
Leach Corporation
Luther Mfg Co
Micro Gee Products
Micrometrical Mfg
M-H Brown Instrs Div
Photobell Co
Poole Instrs Inc
Sanborn Company
Schaevitz Engineering
Servonic Instruments
Swartwout Co
Vinson Mfg Co
Westronics Inc

DISPLACEMENT PICK-UPS, Capacitance Type
Berkeley Dynamics
Decker Corp
Micrometrical Mfg
Milton Roy Co
Photobell Co
Photocon Research
Radiaphone Co

DISPLACEMENT PICK-UPS, Differential Transformer Type
Automatic Timing & Contls
Baldwin-Lima-Hamilton
Collins Corp G L
Daytronic Corp
Engis Equipment
Instrol Inc
International Resistance
Micrometrical Mfg
Norwood Controls
Ram Meter Inc
Sanborn Company
Schaevitz Engineering
Swartwout Co
Vinson Mfg Co

DISPLACEMENT PICK-UPS, Magnetic, Including Variable Reluctance
Aeronaut & Instr Div
BJ Electronics
Collins Corp G L
Consol Electrodynamics
Dynapar Corp
Edison Industries T A
Electro Products Labs
Engis Equipment
Instrol Inc
Land-Air Inc
M-H Boston Div
Sterling Precision
Sunshine Scientific
Vinson Mfg Co

DISPLACEMENT PICK-UPS, Resistive
Chemiquip
Edison Industries T A
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DRAFT INSTRUMENTS (See also Boiler Room instruments, also Pressure)
Bacharach Indus Instr
Bailey Meter Co
Barton Instrument
Bristol Co
Defender Instrument
Dwyer Mfg F W
Ellison Draft Gage
General Controls
GPE Controls
Hagan Chem & Controls
Hays Corporation
Moore Products Co
Reliance Instr Mfg
Uehling Instrument
Victory Egrg Corp

DRYERS, Air or Gas
Air-Shields Inc
Cooper Development
Dryomatic Corp
Fisher Co Oscar
Gas Drying Inc
Hankison Corp
Hayes Inc C I
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Cash Co A W
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Air-Shields Inc
Automatic Switch Co
Avco Corp
Bemco Inc
Blue M Electric
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Conrad Inc
Custom Scientific Instrs
Development Engrg Co
Electric Hotpack
Fischer & Porter Co
G S Equipment
Grain Lab Equip
Greiner Co Emil
Harris Refrigeration
Haskris Co
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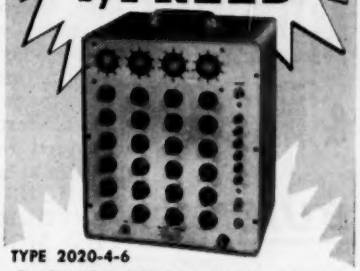
NEW!! MULTIPLE PRESET COUNTER by FREED



TYPE 2020-4-6

The Freed Type 2020-4-6 Multiple Preset Counter was designed for sequential predetermining control and is ideally suited for applications when a machine or a process is started manually and stops automatically at several preset counts in one operation. One of the applications for this counter is the winding of tapped toroidal or transformer coils.

Premium components, simplified circuits, using a minimum of computer type vacuum tubes and a silicon diode power supply provides reliable maintenance free operation.

SPECIFICATIONS
- MAXIMUM COUNT: 4 digits 9,999
- COUNTING RATE: 4000 per second
- PRESETS: 1-6
- INPUT: Photocell, Switch closure, Pulse
- OUTPUT: Relay DPDT — 5 Amp contacts
- SIZE: 11 x 13 x 8½ inches
- WEIGHT: 19½ lbs.
- POWER SUPPLY: 105-125 Volts—50-60 cycles

Freed also manufactures Preset, Totalizing, Batching and Timing counters.

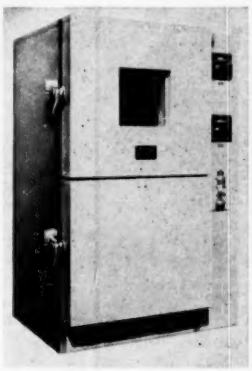
Send for complete information.

FREED TRANSFORMER CO., INC.
1735 Weirfield St., Brooklyn (Ridgewood) 27, N.Y.
CIRCLE 26 ON READER-SERVICE CARD

CREATING ENVIRONMENT . . .

DEVELCO

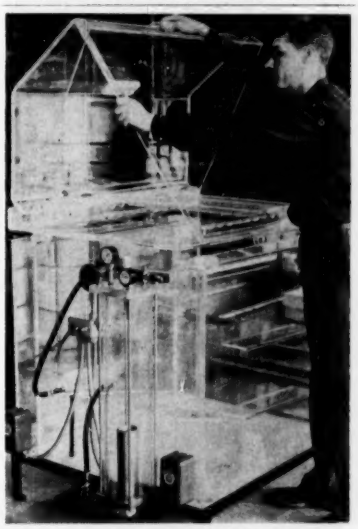
COLD CHAMBERS USING LIQUID CO_2



Low Equipment Cost . .
Easy to Use . .
Quick Pulldown to Minus 100°F . .
Small Chambers To Walk-in Rooms . .
To Meet MIL-E-5272C and others

WRITE FOR INFORMATION

DEVELOPMENT ENGINEERING COMPANY, INC.
9 Cross Street • Norwalk, Connecticut
• *Manufacturers of Environmental Test Equipment*
Salt Spray - Fungus - Cold - Heat - Altitude - Humidity
CIRCLE 25 ON READER-SERVICE CARD



G-S Corrosion Test Cabinets
Highest Uniform Accuracy
Over-All Visibility
At Lower Cost!
★ Salt Fog ★ Humidity Tests
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Meet A.S.T.M. and Gov't Specifications. All-welded H-T Lucite, lined Steel or lined Stainless —sizes, types to suit. Send for new Bulletin, prices.

The G. S. Equipment Co.
15585 Brookpark Rd., Cleveland, Ohio
Phone: CL 2-4770
CIRCLE 27 ON READER-SERVICE CARD

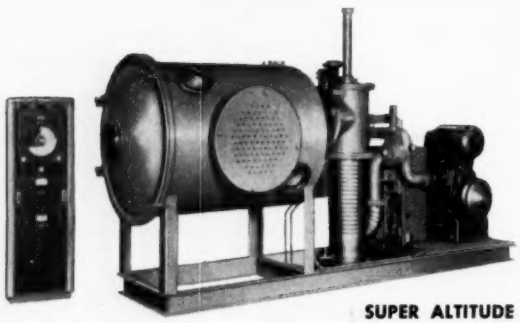
everyone talks about

"RELIABILITY"...

MURPHY & MILLER

BUILDS IT!

Long before "reliability" became the magic word in describing every conceivable type of equipment, Murphy & Miller was building environmental test equipment that delivered reliability in terms that could be measured: CONTINUOUSLY ACCURATE PERFORMANCE UNDER THE MOST RIGOROUS OPERATING CONDITIONS. (We will always build reliability into everything that bears our name.)

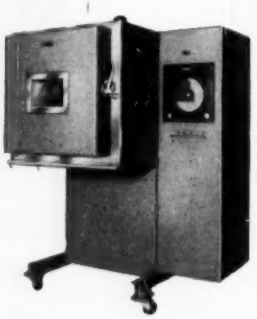


SUPER ALTITUDE SIMULATION CHAMBER

- Sea Level to 350,000 ft. (760 MM Hg to ½ Micron)

COMBINED TEMPERATURE and VIBRATION SIMULATION TEST CHAMBER

- Sizes 1 to 64 cubic feet
- Temperature Range: —120°F. to +300°F
- ALL STAINLESS STEEL TEST SPACE
- Optional Recording, Controlling, and Programming Equipment Available
- Self Elevating Chamber Available (Optional)



COLD TEST CHAMBER

- Temperatures to —200°F
- Stainless Steel Test Space
- Forced Air Circulation
- Heating cycles available to 300°F
- Test space capacities start at 1 cu. ft.

For the best in environmental test equipment, check Murphy & Miller first. Write for illustrated circular.

murphy & miller, inc.

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Engineering Representatives In All Principal Cities

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CIRCLE 28 ON READER-SERVICE CARD

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Labline Inc
Mast Development
Modern Lab Equipment
Murphy & Miller
NRC Equipment
Nanmac Corp
National Appliance Co
Ozone Res & Eqpt Corp
Research Inc
Standard Cabinet Co
Statham Instruments
Temperature Engrg Corp
Tenney Engineering
United Aircraft Prods
United Electric Controls
Webber Engrg Corp
Will Corporation
Wyle Mfg Corp

FEEDERS, Automatic Proportioning, Including Granular Material

Aidlin Automation Inc
American Meter Co
B-I-F Industries
Eriez Mfg Co
Fischer & Porter Co
Fuller Co
Gilmore Industries
Gump Co B F
Hills-McCanna
Infilco Inc
Jeffrey Mfg
Lapp Insulator
Milton Roy Co
Natl Instrument Co
Ramsey Engrg Co
Richardson Scale Co
Syntron Co
Thayer Scale Corp
Wallace & Tiernan
Weighing & Control Comps

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Barber-Colman
Edison Industries T A
Edwards Co Inc
Falcon Alarm Co
Fenwal Inc
General Controls
Grinnell Co
Phoenix Precision Instr
Redford Corp
Victory Engrg Corp
Worner Electronic Devices

FLOW CONTROLLERS

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American Meter Co
Automatic Switch Co
Automatic Timing & Contls
B-I-F Industries
Bailey Meter Co
Barton Instrument
Beckman/Berkeley Div
Black Sivalls & Bryson
Bowser Inc
Barbender Instr C W
Bristol Co
Brooks Rotameter
Cash Co A W
Cash Valve Mfg
Chemiquip
Controls Co of Amer
Curtiss Wright
Defender Instrument
Denison Engrg Div
Eastern Industries
Fisc. & Porter Co
Flow Measurements
Foxboro Company
GPE Controls
General Controls
General Regulator
Hagan Chem & Controls
Hallikainen Instrs
Hays Corporation
Hays Mfg Co
Hydromatics Inc
Infilco Inc
Johnson Service Co
Kates Co W A
Kieley & Mueller
Leonard Inc Wallace D
Magnetrol Inc
Manning Maxwell & Moore
Mason Neilan
McDonnell & Miller
Mercoid Corp
M-H Brown Instrs Div
Moore Products Co
Natl Instrument Labs
North American Mfg
Norwood Controls
Pneu-Hydro Valve
Redford Corp
Reliance Instr Mfg
Rockwell Mfg Co
Selco Instr Div
Simplex Valve & Meter
Swartwout Co
Taylor Instrument
Texas Instruments Inc
United Aircraft Prods
U S Gauge Div
Waugh Engrg Co
Weston Instruments

FLOW INSTRUMENTS, Granular Materials

Bailey Meter Co
B-I-F Industries
Bin-Dicator Co
Curtiss Wright
Flow Measurements
Scrayco Mfg
Wallace & Tiernan
Westronics Inc

FLOW NOZZLES

B-I-F Industries
Bailey Meter Co

You can DEPEND on --

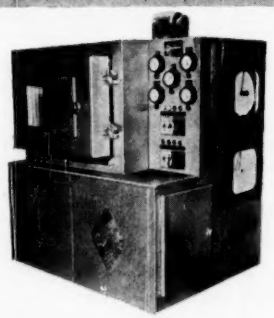
Standard

TEST CABINETS

FOR ACCURATE DEPENDABLE ENVIRONMENTAL TESTS

self-contained units to meet every condition

HIGH and LOW TEMPERATURES, ALTITUDE, HUMIDITY, FUNGUS, SAND and DUST, SALT SPRAY, RAIN and SUNSHINE, EXPLOSION and SPECIAL APPLICATIONS.



Every Standard test cabinet is designed for reliable and accurate testing, along with years of care-free durable operation. Whatever the simulated condition is desired to test your product accurately . . . correctly, there is a Standard cabinet to do the job. All guaranteed to give high level performance — the result of a decade of engineering skill and experience in designing and fabricating test equipment. Why not look into the many outstanding features offered by Standard today . . . send for our illustrated Catalog No. 59.

EQUIPMENT AVAILABLE TO MEET ALL GOVERNMENT SPECIFICATIONS

WALK-IN EQUIPMENT DESIGNED AND FABRICATED TO ORDER

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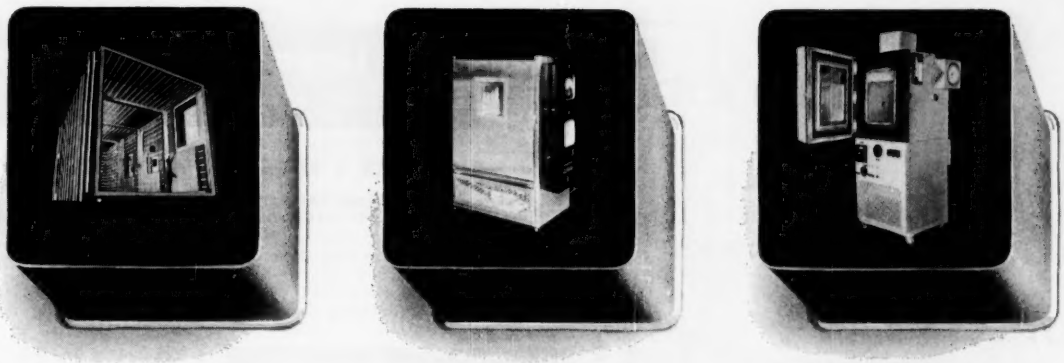
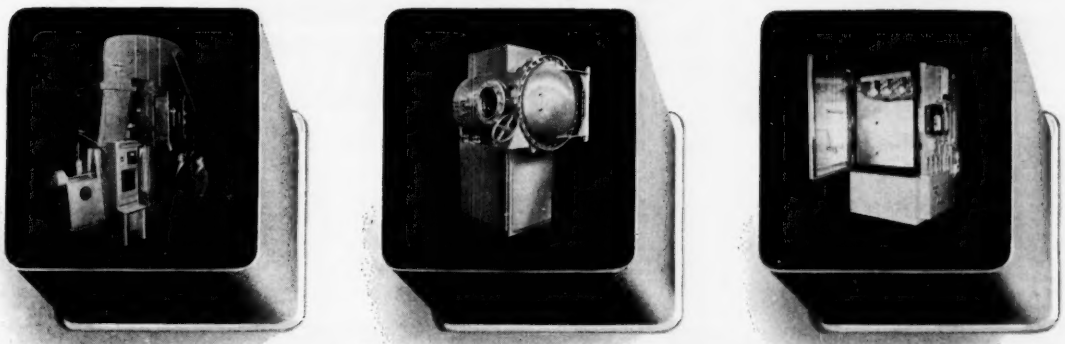
Standard CABINET COMPANY

53 WASHINGTON AVENUE
CARLSTADT, NEW JERSEY

DESIGNERS-MANUFACTURERS OF TEST EQUIPMENT

CIRCLE 29 ON READER-SERVICE CARD





Tenney push-button environments

. . . any size, any shape, anytime!

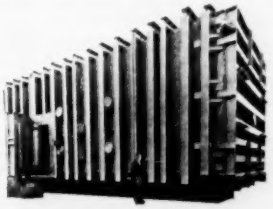
No matter what environmental test chamber you need, this much is certain: Tenney either has it in stock or can adapt one of its proven prototypes. From chambers that could house a family of four, down to refrigerator size (and everything in between), you're sure to find the modern, push-button unit you need.

Altitude, temperature, humidity, explosion, sand, dust, fog—just about every punch nature can throw—can be simulated, either alone or in combination. And you get accurate simulation, complete control and precise measurements every time.

For a complete catalog, describing the entire line, write today to Tenney—the world's largest, most experienced creator of environmental test equipment.

Ask about Tenney's research and development, engineering consultation and design services.

Tenney
ENGINEERING, INC.



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OLDEST AND LARGEST MANUFACTURER OF ENVIRONMENTAL EQUIPMENT

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f/b-LINE
TRANSMITTERS

For Flow, Differential Pressure, and Level Measurements

• Pneumatically transmit rate of flow or differential pressure measurements to indicating, recording, and/or controlling equipment at remote stations. Transmitters consist of a diaphragm measuring mechanism and force-balance pneumatic transmitting unit.

For measurement of steam, water, air, gases, and other fluids with ranges from 0-1 in. H_2O to 2000 in. H_2O at maximum service pressures up to 5000 psig.

Differential range of each diaphragm measuring element may be changed by a factor of 10 to 1 by a simple screwdriver adjustment.

Flow transmitter produces pneumatic signal which is directly proportional to flow, thus eliminating the need for external square-root extractors or characterizers.

Request Product Specification P22-1 for flow, P21-1 for differential pressure and P31-1 for level.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd., Montreal, Canada

CIRCLE 31 ON READER-SERVICE CARD

BAILEY

AREA METER TRANSMITTERS

Transmits a signal which is directly proportional to rate of flow to indicating, recording, integrating, and/or controlling equipment at remote stations.

For rate of flow measurement of water, kerosene, gasoline, oil, tar, chemicals, distillates, and refrigerants. Measures rate of flow over a 50 to 1 range. Mounts directly in pipe line.

Signals may be transmitted either electrically or pneumatically.

Request Product Specification E22-4 for electric transmission and Product Specification P22-4 for pneumatic transmission.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd., Montreal, Canada

CIRCLE 32 ON READER-SERVICE CARD

Model 20

Vol-O-Flo Linear Gas Flowmeter

For Laboratory Plant Special Equipment

ACCURATE • RUGGED • ADAPTABLE

Meters using laminar flow elements have the highest potential accuracy possible. Accuracy is independent of pipe run. Convenient to use. Available for table, pipe, wall, or flush mounting. Specials to order: Pressure to 2000 psig, temperature to 500° F, overflow checks, H-assemblies. Dial indicator type (Model 30) and element only (Model 10, for customer secondary device) are also available.

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Washington, D. C.
NOrth 7-7582

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Hagan Chem & Controls
Haveg Industries
Simplex Valve & Meter
Taylor Instrument

FLOW PICKUPS, Turbine Type (see also Orifice Plates, Venturi Tubes, Pitot Tubes, Flow Nozzles

Aero Research Instr
Barton Instrument
Cox Instruments
Dwyer Mfg F W
Dynamic Instr
Fischer & Porter Co
Gilmore Industries
Natl Instrument Labs
Waugh Engrg Co

FLOW PROVERS

American Meter Co
Brooks Rotameter
Industrial Instr Corp
Porter Inc Geo K
Rockwell Mfg Co
Waugh Engrg Co

FLOW REGULATORS, Self-Operated

Associated Valve Co
B-I-F Industries
Bailey Co Chas M
Bailey Meter Co
Barton Instrument
Black Sivalls & Bryson
Bush Associates G F
Defender Instrument
Denison Engrg Div
Cash Co A W
Cash Valve Mfg
Fischer & Porter Co
General Controls
Grove Valve & Regulator
Hays Mfg Co
Hydromatics Inc
Kates Co W A
Kieley & Mueller
Leonard Inc Wallace O
Moore Products Co
North American Mfg
Pneu-Hydro Valve
Redford Corp
Reliance Instr Mfg
Rebulic Mfg Co
Seico Instr Div
United Aircraft Prods
U S Gauge Div
Victor Equipment
Vinson Mfg Co
Wallace & Tiernan
Weston Hydraulics Ltd

FLOW TOTALIZERS

American Meter Co
B-I-F Industries
Bailey Meter Co
Barton Instrument
Beckman/Berkeley Div
Bristol Co
Brooks Rotameter
Dynapar Corp
Fischer & Porter Co
Flow Measurements
Foxboro Company
GPE Controls
Hagan Chem & Controls
Hallikainen Instrs
Industrial Measurements
Librascope Inc
M-H Brown Instrs Div
Natl Instrument Labs
Simplex Valve & Meter
Swartwout Co
Wallace & Tiernan
Waugh Engrg Co

FLOW TRANSMITTERS

American Meter Co
Automatic Timing & Contls
Bailey Meter Co
Barton Instrument
B-I-F Industries
BJ Electronics
Black Sivalls & Bryson
Bristol Co
Brooks Rotameter
Conoflow
Cox Instruments
Detroit Controls
Exactel Instrument
Fischer & Porter Co
Flow Measurements
Foxboro Company
General Regulator
GPE Controls
Hagan Chem & Controls
Hallikainen Instrs
Hastings-Raydist
Hays Corporation
Industrial Instr Corp
Manning Maxwell & Moore
Mason Neilan
M-H Brown Instrs Div
Moore Products Co
Natl Instrument Labs
Norwood Controls
Pace Engrg Co
Rahm Instruments Div
Revere Corp of Amer
Schutte and Koerting
Simplex Valve & Meter
Swartwout Co
Taylor Instrument
Trans-sonics
United Electric Controls
U S Gauge Div
Waugh Engrg Co

FLOWMETERS, Area, including Cone and Disc Type, Cylinder and Piston Type, Free Float Type

Acme Industrial Co
American Gas Furnace
Amer Meas & Control
Bayley Instrument
Brooks Rotameter
Cox Instruments
Defender Instrument
Dezurik Corp
Dietz Co Henry G
Fischer & Porter Co
Hallikainen Instrs
Hays Corporation
Hoke Inc
M-H Brown Instrs Div
New Jersey Meter Co
Penn Instruments
Phoenix Precision Instr
Porter Inc Geo K
Scanivalve Sales Co
Schutte and Koerting
Seico Instr Div
Simplex Valve & Meter
Victor Equipment
Waukee Engineering

FLOWMETERS, Area, Orifice and Plug Type

Acme Industrial Co
Amer Meas & Control
American Meter Co
Auto-Control Labs
Bailey Meter Co
Bristol Co
Brooks Rotameter
Chemquip
Cox Instruments
Dwyer Mfg F W
Ellison Draft Gage
Fischer & Porter Co
Hays Corporation
King Engrg
Librascope Inc
Meriam Instr Co
M-H Brown Instrs Div
Natl Instrument Labs
Porter Inc Geo K
Robinson Orifice
Schutte and Koerting
Seico Instr Div
Taylor Instrument

FLOWMETERS, Electro-Magnetic, including Turbine

Air Conditioning Equip
Bowser Inc

Measure-Control Liquid Volume with NIAGARA METERS

• Chemicals • Oils & Solvents
• Cold & Hot Water • Syrups, etc.

Single nutating piston volumetric displacement metering, with integrating registers, or explosion proof Electricontact construction. Indicating, recording and controlling attachments also available. Inquire now!

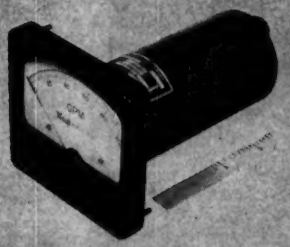
BUFFALO METER CO.
INCORPORATED
2906 Main Street **Buffalo, N. Y.**

CIRCLE 34 ON READER-SERVICE CARD

Flow Measurement and Control by Waugh

Six precision measurement devices . . . a sampling of the many developed through Waugh's creative engineering. When planning for the most advanced systems, take advantage of Waugh's ability to meet tomorrow's requirements today.

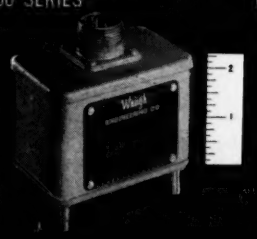
FLOW RATE INDICATOR FR-305



Combines indicating meter with transistorized frequency-to-voltage converter in a single compact package.

- Optional 115v ac or 28v dc power supply.
- Accurate to 1% of full scale.
- Custom scales for all flow ranges and measurement units.
- 250° scale instruments also available.

TRANSISTORIZED FREQUENCY-TO VOLTAGE CONVERTER FR-300 SERIES



For flow rate or R.P.M. measurements. Combines compact size with high stability and precision.

- 3" x 2" x 2⅛" overall size.
- 0-5 volts output. 0-1 milliampere also available.
- Better than .002% per degree temperature coefficient.

TURBINE FLOW SENSOR FF-FB SERIES

Converts fluid flow into A.C. frequency proportional to flow rate.

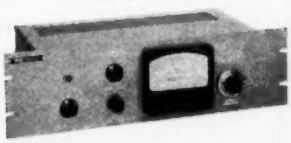
- Exclusive design features low pressure drop . . . high reliability.
- Special series available for gas measurement.
- High frequency models measure flow transients up to 50 cps.

TRANSISTORIZED FREQUENCY DETECTOR FD-100

Provides instantaneous trip signal when input frequency goes above or below preselected limit.

- Used as overspeed trip with tachometer generators or as flow limit switch with turbine flow sensors.
- Trip point accurate within 1%.
- Response time 10 milliseconds maximum.
- 28v output to operate solenoid or relay.

PULSE RATE CONVERTERS SERIES FR-100 AND 200



For converting frequency output of turbine flowmeters or tachometer generators into a DC signal.

- Cabinet or relay rack styles.
- Multiple input channels with built-in indicator.
- 5 to 3000 cps. input frequency range.
- High frequency model gives transient response to 50 cps.

FLIGHT REFUELING FLOWMETER

Used in tanker aircraft to register total fuel transferred.

- Complete system includes sensor and indicator only; no intermediate devices.
- All-transistor circuitry provides high reliability; no mechanical switches.
- Includes circuit to turn on indicator light when fuel is flowing.

Bulletins giving complete physical and technical data on these and other Waugh products will be sent on request. Our engineering staff is available to assist in the development and manufacture of other precision components you may require.

Waugh

ENGINEERING CO.

7842 Burnet Ave. • Van Nuys, Calif.

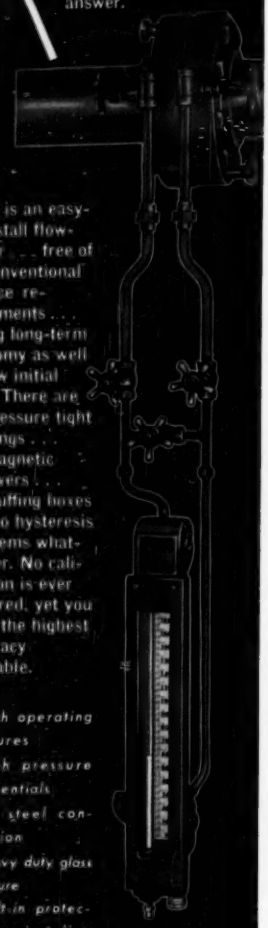
Sales representatives in principal cities

CIRCLE 35 ON READER-SERVICE CARD

UNMATCHED ACCURACY

in direct flow indication

Wherever you seek simplicity and high accuracy in flow measurement at lowest cost, the Meriam "H" Meter is the well-known answer.



Here is an easy-to-install flowmeter . . . free of all conventional service requirements . . . giving long-term economy as well as low initial cost. There are no pressure tight bearings . . . no magnetic followers . . . no stuffing boxes . . . no hysteresis problems whatsoever. No calibration is ever required, yet you have the highest accuracy available.

★ High operating pressures
★ High pressure differentials
★ All steel construction
★ Heavy duty glass enclosure
★ Built-in protection against line surges

Write for Bulletin 18A

Meriam Manometer Instrumentation ...for pressures, vacuums, flows, liquid levels.

meriam

INSTRUMENT COMPANY

10920 Madison Ave. • Cleveland 2, Ohio

CIRCLE 36 ON READER-SERVICE CARD

Cox Instruments
Fischer & Porter Co
Foxboro Company
Flow Measurements
Revere Corp of Amer
Taylor Instrument
Vinson Mfg Co
Waugh Engrg Co

FLOWMETERS, Inferential Type, including Orifice, Nozzle, Pitot, Venturi: for Air, Gas, Liquid or Steam; Indicating and/or Recording

Aero Research Instr
Amer Meas & Control
B-I-F Industries
Bailey Meter Co
Barton Instrument
Bristol Co
Brooks Rotameter
Commercial Iron Works
Defender Instrument
Ellison Draft Gage
Fischer & Porter Co
Foxboro Company
Hagan Chem & Controls
Has Ings-Raydist
Hays Corporation
Industrial Instr Corp
Infilco Inc
King Engrg
Meriam Instr Co
M-H Brown Instrs Div
Natl Instrument Labs
Norwood Controls
Penn Instruments
Porter Inc Geo K
Robinson Orifice
Rockwell Mfg Co
Selco Instr Div
Simplex Valve & Meter
Taylor Instrument
United Aircraft Prods
Victor Equipment

FLOWMETERS, Magnetic

Fischer & Porter Co
Foxboro Company
Hays Corporation
M-H Brown Instrs Div
MSA Research Corp
Performance Measurements
Schutte and Koerting
Selco Instr Div

FLOWMETERS, Open Channel, including Flume, V-notch, Weir (see also Waste)

Bailey Meter Co
B-I-F Industries
Bristol Co
Brooks Rotameter
Dezurik Corp
Fischer & Porter Co
Foxboro Company
Hagan Chem & Controls
M-H Brown Instrs Div
Penn Instruments
United Aircraft Prods

FLOWMETERS, Positive Displacement, including Consumer Gas, Nutating Pistons or Disc, Oscillating Platen, Propeller, Reciprocating Piston and Rotary Piston Water Meters, etc.

American Meter Co
Auto-Control Labs
Badger Meter Mfg
B-I-F Industries
Bowser Inc
Buffalo Meter
Fischer & Porter Co
Gurley W & L E
Hays Corporation
Industrial Measurements
InstruLab Inc
Lapp Insulator
Neptune Meter
Porter Inc Geo K
Revere Corp of Amer
Rockwell Mfg Co
Victor Equipment

FLOWMETERS, Sight

Bowser Inc
Cox Instruments
Dietz Co Henry G
Fischer & Porter Co
Greiner Co Emil
New Jersey Meter Co
Petrometer Corp
Schutte and Koerting
Selco Instr Div
Selas Corp of America
Victor Equipment

FLOWMETERS, Vane Type

Air Conditioning Equip
Bailey Meter Co
Bowser Inc
Fischer & Porter Co
Illinois Testing Labs
New Jersey Meter Co
Selco Instr Div
Standard Controls Inc

FURNACE CONTROL SYSTEMS (see Boiler Room Instruments, also Combustion Safeguards)

Astra Technical Instr
Bailey Co Chas M
Bailey Meter Co
Bristol Co
Defender Instrument
Diamond Power Specialty
Eclipse Fuel Engrg
Ellison Draft Gage
Energy Kontrols
Foxboro Company
General Controls
GE Apparatus Sales Div
General Regulator
GPE Controls
Hagan Chem & Controls
Ipsen Industries
Kieley & Mueller
Leeds & Northrup
McIlvaine O T
Moore Products Co
Panellit Inc
Pimex Inc
Reliance Instr Mfg
Thermo Electric
Thermco Instrument
Westinghouse Director Sys
Weston Instruments
Westronics Inc

GAS ANALYZERS, Air

Axler Associates
Bacharach Indus Instr
Crump Instrument
Gelman Instrument
Industrial Instruments
Interelectronics
Mine Safety Appliances
Beckman/Sci & Proc Div
Davis Instruments
Fischer & Porter Co
Fisher Scientific
Fuller Co
Loe Engrg Co
National Spectrographic
Phoenix Precision Instr
Thermco Instrument
Victory Engrg Corp

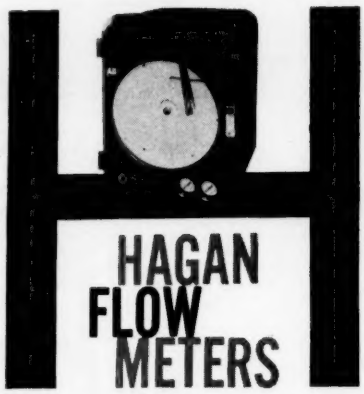
GAS ANALYZERS, Ammonia

Beckman/Sci & Proc Div
Baird-Atomic Inc
Crump Instrument
Davis Instruments
Epic Inc
Fischer & Porter Co
Fisher Scientific
Gow-Mac Instrument
Hallikainen Instrs
Industrial Instruments
Johnson-Williams
Loe Engrg Co
Mine Safety Appliances
Ranarex Div
Thermco Instrument
Universal Match

GAS ANALYZERS, Carbon Dioxide, and/or Carbon Monoxide

American Data Div
American Electronics Inc
Bacharach Indus Instr
Baird-Atomic Inc
Beckman/Sci & Proc Div
Cambridge Instrument
Crump Instrument
Davis Instruments
Defender Instrument
Dwyer Mfg F W
Ellison Draft Gage
Epic Inc
Fischer & Porter Co
Fisher Scientific
Gow-Mac Instrument
Greiner Co Emil
Hays Corporation

When Using This Guide look under the variable, e.g., Pressure Gages (not Gages, Pressure); or look under the noun—Magnets, Permanent (not Permanent Magnets).



HAGAN FLOW METERS

For recording, indicating, integrating or control of flows, Hagan Ring Balance meters offer these unique features:

1. High sensitivity at low flows.
2. Easy calibration under operating static pressures.
3. Sealing fluid density and level not critical.
4. Interchangeable ring assemblies for full scale ranges from 0.5" w.c. to 560" w.c. Adjustment on any one ring over a 7:1 differential range.
5. Built-in wide range computation and/or compensation.

HAGAN CHEMICALS & CONTROLS, INC.

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.

In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

CIRCLE 37 ON READER-SERVICE CARD

BAILEY

Fluid Meters

FOR STEAM-LIQUIDS-GASES

• Bailey Fluid Meters are designed to indicate, record, and/or integrate the flow of steam, liquids, or gases under practically any pressure or temperature conditions.

One to four records may be made on a single 12 in. circular chart or two records of flow may be combined in the same case with two integrators or two pneumatic controllers.

Either pneumatic or electric transmission may be used when it is desired to place the Receiver Recorder at a distance from the primary element.

Request Bulletin 20.

BAILEY METER COMPANY

1041 IVANHOE ROAD CLEVELAND, O

Bailey Meter Company, Ltd. Montreal, Canada

CIRCLE 38 ON READER-SERVICE CARD

PROCESS GAS ANALYZERS

THERMCO SPECIALIZES IN ANALYZERS FOR THE FOLLOWING GASES:

- Oxygen
  - Oxygen Purity
  - Trace Oxygen Measurements
  - Intermediate Oxygen Measurements
- Argon Purity
- Hydrogen Purity
- Hydrogen in Furnace Atmospheres
- Carbon Dioxide

and—
Numerous other process control and portable instruments.

We will gladly supply you with complete information on these instruments . . . write:

THERMCO Instrument CORPORATION

Highway U.S. #20

LA PORTE, INDIANA

CIRCLE 39 ON READER-SERVICE CARD

Industrial Instruments
Instr Development Co
Interelectronics
Kruger Instrs Harold
Leeds & Northrup
Loe Engrg Co
Mine Safety Appliances
Thermco Instrument
Uehling Instrument
Universal Match
Victory Engrg Corp

GAS ANALYZERS, Hydrogen, Hydrogen Sulphide, Nitric Oxide, etc.

American Electronics Inc
Bailey Meter Co
Beckman/Sci & Proc Div
Cambridge Instrument
Consol Electrodynamics
Crump Instrument
Davis Instruments
Engelhard Industries
Epic Inc.
Fisher Scientific
Fuller Co
Gelman Instrument
Gow-Mac Instrument
Hastings-Raydist
Hays Corporation
Industrial Instruments
Instr Development Co
Johnson-Williams
Kruger Instrs Harold
Leeds & Northrup
Loe Engrg Co
Mine Safety Appliances
M-H Rubicon Instrs Div
Ranarex Div
Swartwout Co
Thermco Instrument
Universal Match

GAS ANALYZERS, Orsat

Apex Scientific Co
Bacharach Indus Instr
Crump Instrument
Defender Instrument
Ellison Draft Gage
Epic Inc
Fisher Scientific
Greiner Co Emil
Hays Corporation
Mine Safety Appliances
Scientific Glass App

GAS ANALYZERS, Oxygen

Bacharach Indus Instr
Bailey Meter Co
Beckman/Sci & Proc Div
Cambridge Instrument
Consol Electrodynamics
Crump Instrument
Davis Instruments
Defender Instrument
Ellison Draft Gage
Epic Inc
Fisher Scientific
Fuller Co
Gow-Mac Instrument
Greiner Co Emil
Hastings-Raydist
Hays Corporation
Industrial Instruments
Interelectronics
Leeds & Northrup
Loe Engrg Co
Milton Roy Co
Mine Safety Appliances
Thermco Instrument
Universal Match

GAS ANALYZERS, Nitrogen

Beckman/Sci & Proc Div
Cambridge Instrument
Crump Instrument
Davis Instruments
Defender Instrument
Epic Inc
Gow-Mac Instrument
Industrial Instruments
Instr Development Co
Loe Engrg Co
Mine Safety Appliances
Ranarex Div
Thermco Instrument
Universal Match

GAS ANALYZERS, Sulphur Dioxide

Cambridge Instrument
Consol Electrodynamics
Crump Instrument
Davis Instruments
Epic Inc
Fisher Scientific
Hays Corporation
Industrial Instruments
Instr Development Co
Loe Engrg Co
Kruger Instrs Harold
Leeds & Northrup
Mine Safety Appliances
Ranarex Div
Thermco Instrument
Universal Match

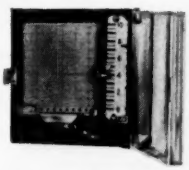
GAS DISTRIBUTION SYSTEM INTRUMENTS, including Gas Station Meters, Pipe Line Instrumentation, Pressure Regulators, Station Instrumentation, etc.

Air Conditioning Equip
American Meter Co

Miniature Graphic Panel instruments for pneumatic transmission

This new system measures, indicates, records and controls pressure (5 in. water to 10,000 psi), absolute pressure (5mm mercury absolute and up), temperature, vacuum, flow, differential pressure, liquid level, and mechanical motion.

The only instrument that fully carries out the basic graphic-panel idea. Includes full plug-in-service and continuous valve position indication. There are 38 receivers and 36 controller models and the widest variety of transmitters on the market. A model is available that will exactly meet every requirement.



Bristol Metagraphic Recorder

Write for bulletin A128 today.

BRISTOL COMPANY

112 Bristol Rd., Waterbury 20, Conn.

CIRCLE 40 ON READER-SERVICE CARD

Strain Gage Instrumentation

edited by Aronson and Nelson. " . . . a practical text . . . covers fundamentals, basic bridge circuits, typical applications, and surveys typical commercial instruments which use or are used with strain gages." Paper, 110 pages, illustrated, indexed by company, author, and subject, 1958. **$2.00**

The Computer Handbook

edited by M. H. Aronson. A clear introduction to the entire field of electronic computers and data processors. Presentations by computer manufacturers at the Second Computer Clinic. Paperbound, 72 pages, 1956. **$2.00**

INSTRUMENTS PUBLISHING CO.

845 Ridge Ave., Pittsburgh 12, Penna.

INSTRUMENT DAVIS DIVISION

GAS ANALYSIS INSTRUMENTS

Continuous and Portable units

✓ **CHROMATOGRAPHIC ANALYZERS**

Complete systems for laboratory and process stream analysis — control.

CHROMA-CAT series extends utility of analysis, allows use of AIR as carrier gas.

✓ **ELECTRO-CONDUCTIVITY ANALYSIS**

Continuous measuring for PART PER MILLION toxic gases in work areas; impurity control in process streams. Applicable on any gases (or gas combustion products) which ionize in water.

✓ **COMBUSTIBLE GAS ANALYZERS**

REMOTE HEAD and multi-point systems for detection of combustible gases and vapors in work areas; Litho and coating oven atmosphere control; etc. Control of combustibles in inert gas streams.

✓ **THERMAL CONDUCTIVITY ANALYZERS**

MEASUREMENT of concentration of one gas component in a mixture of gases utilizing sensitive T/C filaments as the detector. Applicable for determination of: H_2 in $O_2 \cdot N_2$ mixtures; Argon in Air; Hydrogen purity; CO_2 in flue gas, etc.

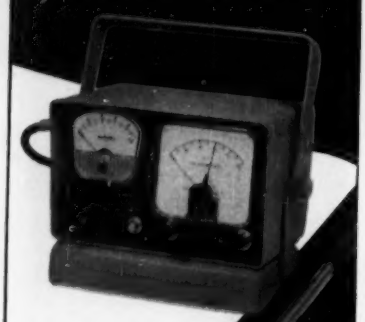
Write for Descriptive Literature

DAVIS INSTRUMENTS

A Division of Davis Emergency Equipment Co., Inc.

CIRCLE 41 ON READER-SERVICE CARD

GAS DETECTORS



MODEL 521
hand carried instrument for quick, accurate detection of hydrocarbon gases.

- COMPLETE LINE OF PRODUCTION MODELS
- Portable units
- Meter — Siren — Light Alarms
- Multi-Channel units with individual alarm readings

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A subsidiary of
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Houston 24, Texas • P. O. Box 19367

CIRCLE 42 ON READER-SERVICE CARD

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Bailey Meter Co
Barton Instrument
Bristol Co
Designs for Tomorrow
Detroit Controls
Deutsch Co
Eclipse Fuel Engrg
Fischer & Porter Co
Fisher Governor
Foxboro Company
GPE Controls
GE Apparatus Sales Div
Hagan Chem & Controls
Industrial Instr Corp
Kieley & Mueller
M-H Brown Instrs Div
Nanmac Corp
Norwood Controls
Ranarex Div
Research Controls
Rockwell Mfg Co
Standard Electric Time
United Electric Controls
U S Gauge Div
Victor Equipment
Weston Instruments

HEAT FLOW, instruments and transducers

Acromag Inc
Atkins Technical Inc
BJ Electronics
High Temperature Instrs
Lewis Engrg Co
Nanmac Corp
Natl Instrument Labs
Norwood Controls
Powers Regulator
Pyrometer Instr Co
Radiation Electronics
Sunshine Scientific
United Aircraft Prods

HUMIDISTATS

General Controls
Johnson Service Co
Powers Regulator
United Electric Controls
Universal Dynamics
Universal Match

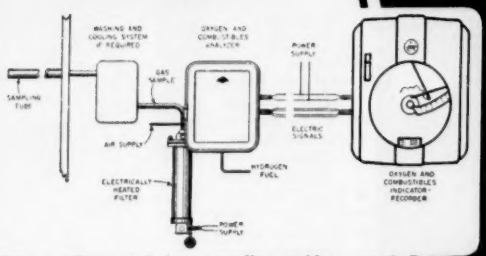
HUMIDITY CONTROLLERS

Air-Shields Inc
Bristol Co
Bush Associates G F
Foxboro Company
Grinnell Co
Johnson Service Co
Mason Neilan
M-H Brown Instrs Div

GAS ANALYZERS

BAILEY METERS

for Oxygen & Combustibles Content of Gases



This sampling, analyzing, recording and/or controlling system provides continuous and independent analysis of oxygen and/or combustibles. Analyzer uses hydrogen and/or air for catalytic combustion of sample. Minimum range: 0-5%; maximum range: 0-25%.

Ideal combustion guide and safety device for furnaces, kilns, and heaters. Analyzes and controls output from atmosphere generators.

Request Product Specification:

E65-1 for O_2 and Comb. Analyzer
E65-2 for O_2 Analyzer
E65-3 for Comb. Analyzer
E65-5 for HEAT PROVER
HEAT PROVER: Portable Combustion Analyzer

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND 10, OHIO

CIRCLE 44 ON READER-SERVICE CARD

BAILEY
MINI-LINE
MANUAL LOADER

- Provides an operator with manual control of remote pneumatic power units. Includes single or duplex indications on a single scale. Uses sensitive, high-capacity, hand-operated air relay.

Standard loaders available for the following operations: Set Point (indicates loading and monitor); Bias (indicates loading and biased loading); and Basic (indicates loading only).

Vibration and shock proof construction makes the Bailey **MINI-LINE** Manual Loader suitable for marine, mobile, and other severe operating service.

Request Product Specification P99-2.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd., Montreal, Canada

CIRCLE 43 ON READER-SERVICE CARD

"The Best Book of its kind—not only on Glass Blowing but on hundreds of techniques"

Scientific and Industrial Glass Blowing and Laboratory Technique

By
WILLIAM E. BARR
And
VICTOR J. ANHORN
Gulf Research and Development Co.

408 PAGES
300 FIGURES, most consisting of several diagrams.
24 TABLES
EXPERTLY-COMPILED INDEX

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Remittance must accompany order

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Pittsburgh 12, Pa.

GAS ANALYZERS
(thermal conductivity)

- "Therma Bridge" Gas Analyzer for monitoring gas stream purity values and general thermal conductivity applications.
- "Therma Bridge" Power Supply & Control Unit for balancing and activating sensing cells.
- "Therma Bridge" Stabilized Temperature Sensing Unit for measuring low impurity percentages in gas analysis and chromotography. Also for thermal conductivity measurements at elevated temperatures.
- "Therma Bridge" Sensing Cells in two metal-mass weights; open-core, heavyweight, hexagonal unit; lightweight, individual cavity type.

Write For Complete Catalog

Industrial Instruments Inc.
89 Commerce Road Cedar Grove Essex County N J

CIRCLE 45 ON READER-SERVICE CARD

King Instruments

MANOMETERS:

U-TUBE—SINGLE CLEANOUT

Simple, sturdy instruments for measuring vacuum or pressure to 250 psi. Cleanout construction; steel, brass, or stainless steel; 6" thru 50" lengths.

DOUBLE CLEANOUT

U-tube type, but using two straight glass tubes with cleanout head at each end. Tested for 250 psi. Steel, brass, or stainless steel; 6" thru 130" lengths.

WELL TYPE

For all types of mounting. Have demountable well, easy to service. Steel, or stainless steel; 6" thru 130" lengths.

RAISED-WELL TYPE

For measuring both pressure and vacuum, or with 3" scale adjustment for measuring absolute pressure. Scale in inches of mercury or feet of altitude.

PHOTO-MANOMETERS

Backlighted for photographing readings. 2 to 100 tubes, to 170" length.

WRITE for literature on items of interest.

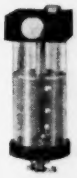
LIQUID LEVEL GAUGES

King-Gages of laboratory precision, graduated in inches, gallons or pounds—for every kind of liquid, in vented or pressurized tanks. Brass or stainless steel; 6" thru 88" lengths.

AIR FLOW SNUBBER

Holds rate of flow of air or gas at .04 cfm for purging instrument air lines.

Is also a pulsation damper for use with pressure gauges and recorders.



AIR SIGHT-FEED BUBBLER

Indicates rate of flow by rise of bubbles thru liquid in glass or plastic cylinder. Needle valve gives precise flow adjustment. Tested for 100 psi.

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Used in small-diameter air or gas lines to indicate presence of moisture by change in color of desiccant. Tested for 100 psi.

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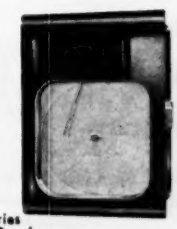

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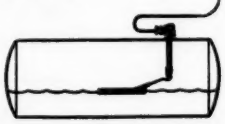

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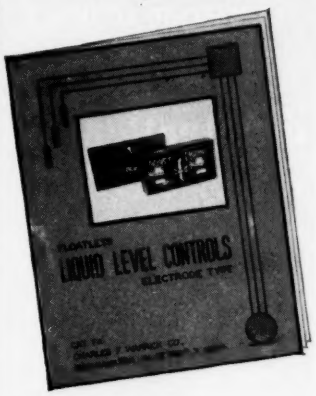

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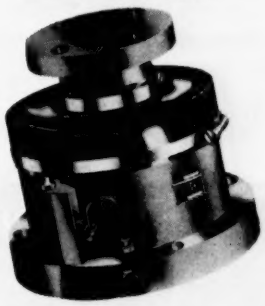

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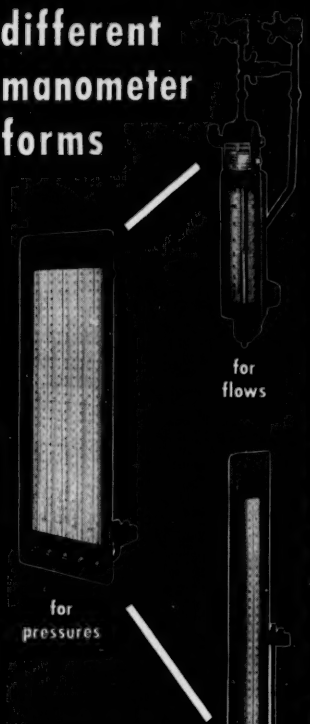

for flows

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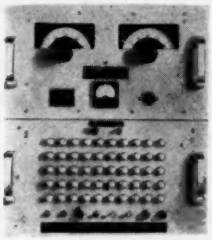

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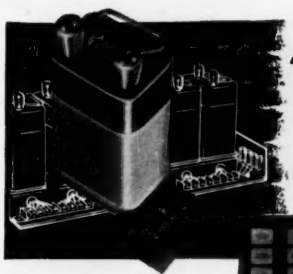

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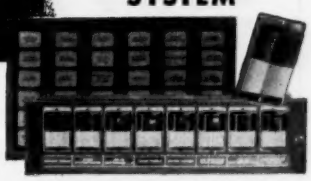

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"Protecting America's Industry"

CIRCLE 60 ON READER-SERVICE CARD

For pH control applications, the Hagan system consists of a standard glass electrode and preamplifier, plus a Hagan Model H-O PowrLog receiver for recording and control.

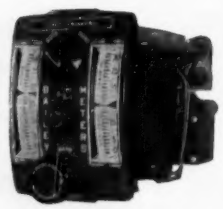
Operating with a high degree of accuracy, the Hagan system provides measurement over a pH span of 2 to 12. The system is simple, easy to install and easy to maintain.

HAGAN CHEMICALS & CONTROLS, INC.

DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Piumendosa No. 13, Milano, Italy

CIRCLE 61 ON READER-SERVICE CARD



BAILEY
MINI-LINE
SELECTOR STATION

- Provides all necessary indications and controls for "bumpless" transfer and for complete automatic or hand operation of a pneumatic control system. Used as a combustion trend indicator, hand-auto selector, and set point or biasing adjuster.

May include as many as four indications of vital control system signals. Vibration and shock proof construction makes the Bailey MINI-LINE Selector Station suitable for marine, mobile, and other severe operating service.

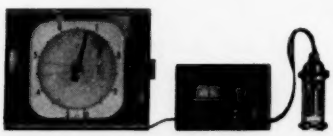
Request Product Specification P99-1.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd. Montreal, Canada

CIRCLE 62 ON READER-SERVICE CARD

pH Automatic Controllers and Recorders

Bristol makes a very wide variety of pH Automatic Controllers and Recorders in round- and strip-chart models. The application of pH instruments in industry was pioneered by Bristol nearly 20 years ago. Thousands of Bristol pH Controllers and recorders are in use today in almost every industry. They are known for their high accuracy and rugged construction. Complete information on models offered and method of application is given in 36-page bulletin Q1304. Write for copy.



BRISTOL COMPANY 112 Bristol Rd., Waterbury 20, Conn.

CIRCLE 63 ON READER-SERVICE CARD

PH CONTROLLERS, INDICATORS and/or RECORDERS

Analytical Measurements
Appalachian Electronic
Assembly Products Inc
Bailey Meter Co
Barber-Colman
Beckman/Scl & Proc Div
Bristol Co
Cambridge Instrument
Coleman Instruments Inc
Electric Eye Equip
Fisher Scientific
Foxboro Company
GE Apparatus Sales Div
Greiner Co Emil
Hagan Chem & Controls
Hays Corporation
International Instrument
Leeds & Northrup
Milton Roy Co
M-H Brown Instrs Div
Phoenix Precision Instr
Process & Instruments
Sel-Rex Corp
Taylor Instrument
Thermo Electric
United Electric Controls
Wallace & Tiernan
Weston Instruments
Westronics Inc

PHOTOELECTRIC CONTROLS, including Counters, Door Openers, etc. (see also Counters, Photoelectric—Cat. 2)

Allied Radio
Analogue Controls Inc
Autotron Inc
Berkeley Dynamics
Clark Controller
Davenport Mfg
Durant Mfg
Dynapar Corp
GE Apparatus Sales Div
GPE Controls
Gurley W & L E
Eastern Specialty Co
Electric Eye Equip
Energy Kontrols
Epic Inc
Hoffman Electronics
Machinery Electrification
McIlvaine O T
Phoenix Precision Instr
Photobell Co
Photomation Inc
Post Electronics
Redford Corp
Reliance Instr Mfg
Specialties Inc
Spectra Electronics
Standard Instrument
Swartwout Co
Tri-Tronics Co
Troit Electronics
Uniwave Inc
Westinghouse Director Sys
Weston Instruments
Wilson & Co G C
Worner Electronic Devices

PITOT TUBES

Aero Research Instr
Dwyer Mfg F W
Ellison Draft Gage
Flow Corporation
Foxboro Company
General Regulator
Haledy Electronics
Hill & Co E Vernon
Infrared Industries
Meriam Instr Co
Research Appliance Co
Slocomb Co J T
Sterling Precision
Wallace & Tiernan

PRESSURE CONTROLLERS and TRANSMITTERS, Absolute or Static Pressure

Allen-Bradley
American Meter Co
Automatic Timing & Contls
Bailey Co Chas M
Bailey Meter Co
Baldwin-Lima-Hamilton
Barton Instrument
Bayley Instrument
Bendix Montrose Div
B-I-F Industries
Black Sivalls & Bryson
Bristol Co
Bulova Research
Burton Mfg Co
Cash Co A W
Cash Valve Mfg
Computer Instruments
Conoflow
Datex Corp
Daytronic Corp
Denison Engrg Div
Detroit Controls
Fairchild Controls
Fischer & Porter Co
Fisher Governor
Foxboro Company
Fulton Sylphon Div
Furnas Electric
General Controls
GPE Controls
Greiner Co Emil
Hagan Chem & Controls
Hass Instrument
Hays Corporation
Healy-Ruff Co
Industrial Engrg Corp
Industrial Instr Corp
Instrol Inc
InstruLab Inc
International Instrument
Johnson Service Co
Kieley & Mueller
Leslie Co
Manning Maxwell & Moore
Mason Neilan
Mercoid Corp
M-H Brown Instrs Div
Moore Products Co
Norwood Controls
Powers Regulator
Rahn Instruments Div
Redford Corp
Reliance Instr Mfg
Scientific Instrument
Seegers Mfg
Seely Instrument
Servo Systems Co
Servonic Instruments
Simplex Valve & Meter
Specialties Inc
Swartwout Co
Taylor Instrument
Trans-Sonics
Uehling Instrument
Ultradyne Inc
United Electric Controls
Westinghouse Director Sys
Weston Instruments

PRESSURE GAGES with Alarms

Acme Gauge & Instr
American Meter Co
Automatic Timing & Contls
Bailey Meter Co
Bristol Co
Crosby-Ashton
Electro Devices (Mo)
Ellison Draft Gage
Fischer & Porter Co
Foxboro Company
General Controls
Hays Corporation
Helicoid Gage Div
Hydel Inc
Manning Maxwell & Moore
Meriam Instr Co
M-H Brown Instrs Div
Murphy Mfg Inc
Newark Controls
Norwood Controls
Panellit Inc
Reliance Instr Mfg
Scientific Instrument
Taylor Instrument
Uehling Instrument
United Electric Controls
U S Gauge Div
Weksler Instruments
Wiancko Engrg Co

PRESSURE GAGES, Absolute Pressure

Automatic Timing & Contls
Bailey Meter Co
Barton Instrument
BJ Electronics
Bristol Co
Consol Electrodynamics
Dynamic Instr
Electric Auto-Lite
Ellison Draft Gage
Fischer & Por er Co
General Controls
Hastings-Raydist
Heise Bourdon Tube
Ideal Precision Meter
Manning Maxwell & Moore
Meriam Instr Co
M-H Brown Instrs Div
Moeller Instr Co
Newark Controls
Norwood Controls
Nurnberg Scientific
Reliance Instr Mfg
Scientific Instrument
Servonic Instruments
Solid State Electronics
Statham Instruments
Taber Instrument
Taylor Instrument
Uehling Instrument
Ultradyne Inc
United Electric Controls
U S Gauge Div
Wallace & Tiernan
Weksler Instruments
Wiancko Engrg Co

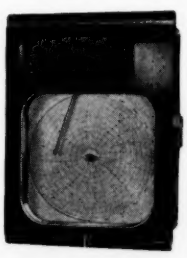
PRESSURE GAGES, Indicating and/or Recorders

Acme Gauge & Instr
American Meter Co
Automatic Timing & Contls
Bailey Meter Co
Baldwin-Lima-Hamilton
Barton Instrument
BJ Electronics
Bristol Co
Consol Electrodynamics
Crosby-Ashton
Daytronic Corp
Defender Instrument
Dickson Co
Dwyer Mfg F W
Electric Auto-Lite
Ellison Draft Gage
Engelhard Industries
Esterline-Angus
Fischer & Porter Co
Foxboro Company
General Controls

Pressure Gauges, Recording and Automatic Control

Bristol Series 500 Gauges come in a very wide variety of models for recording and controlling pressure, draft, vacuum, absolute pressure, liquid level in ranges from 0 to 6 mm of mercury absolute, full vacuum, and from 0 to 3 in. water to 10,000 psi.

These easy-to-use, easy-to-service instruments are highly accurate and extremely stable in all ranges of application.



Write for Bulletins G620 and G621.

BRISTOL COMPANY
112 Bristol Rd., Waterbury 20, Conn.

CIRCLE 64 ON READER-SERVICE CARD

VACUUM and PRESSURE GAUGES

TEST GAUGES—Equal or exceed A.S.A. Grade AA standards. Accuracy within ± ¼% of scale. Sizes from 4½ to 16 inches. **Catalog 400.**

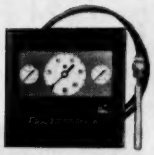
PROCESS GAUGES—The premium SUPERGAUGE line. Accuracy: ± ½% of scale. Available with integral solid front wall for safety. **Catalog 1819.**

"A-LINE" GAUGES—Economical; mid-scale accuracy: ± 1% of scale. Meet all A.S.A. Grade A standards. Cast aluminum case, std. **Catalog 305.**

"O.E.M." GAUGES—Low-cost, drawn case line. Precision-built on volume basis. Midscale accuracy: ±2% of scale. Meet all A.S.A. Grade B standards. **Catalog 64A.**

AUTOMATIC CONTROLLERS

Indicating or Recording



"PILOT" CONTROLLERS—Low-cost pneumatic control. Thermometer or pressure elements. Can be valve mounted. **Catalog 510.**

BY-PASS PANEL mounts below "Pilot" for manual control. **(Bulletin F023).** Another option permits remote pneumatic set point adjustment. **Bulletin F024.**

PILOT-POSITIONER mounts on valve. Combines indicating pneumatic control with quick, accurate valve positioning. Compact and low-cost. **Bulletin F029.**

RECORDING CONTROLLERS with thermometer or pressure elements. Pneumatic or electric contact control. Charts: 6, 9, or 12-in. **Catalog 456A.**

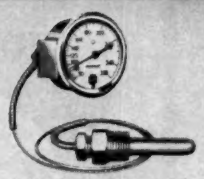
USG INSTRUMENTS AND CONTROLS FOR

Temperatures from —350 to +1000 F • Pressures from 30 in. Hg vac. to 20,000 psi and above

THERM-OMETERS

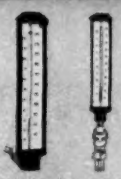
Mercury, Vapor, Gas or Organic Fills

"SUPERTHERM" DIAL TYPE in remote or direct reading (rigid stem or Multi-Angle) styles. Sizes: 3½, 4½, 6 and 8½ in. **Catalog 205.**



DRAWN CASE, DIAL TYPE for O.E.M. applications with lower accuracy requirements. Remote or direct reading styles. Sizes 2 to 8½ in. **Catalog 64A.**

USG RECORDERS—New 12-in. model features modern case with recessed bottom for easier connection. Available for pressure, too. **Bulletin 3025.**



INDUSTRIAL GLASS STEM TYPES with highly visible "Red-reading Mercury." Variety of mountings. Sizes: 5, 7, 9, and 12-in. **Catalog 101.**

PNEUMATIC TRANS-MISSION

PNEUMATIC TRANSMITTERS. Indicate transmitted variable. Match "Pilot" case. Accurate, sensitive, dependable. **Catalog 510.**

PNEUMATIC RECEIVERS. Offered in broad line. Bourdon or diaphragm actuation; 4½ to 16-in.; accuracy: to ¼% of scale; single or duplex. **Catalog 510.**

GAUGE ACCESSORIES

USG accessories include a complete line of chemical attachments and pulsation dampeners. Also, pressure snubbers, gauge fittings, and tools. **Catalog 606.**

Find Your Nearest Distributor In The 'Yellow Pages'

UNITED STATES GAUGE

Division of American Machine & Metals, Inc., 150 Clymer Ave., Sellersville, Pa.

USG®

CIRCLE 65 ON READER-SERVICE CARD

specialists in the manufacturing of gauge components . . . Military Oxygen Gauges

SEEGERS MANUFACTURING CO.

515 W. Main St. • Barrington, Ill.

CIRCLE 66 ON READER-SERVICE CARD

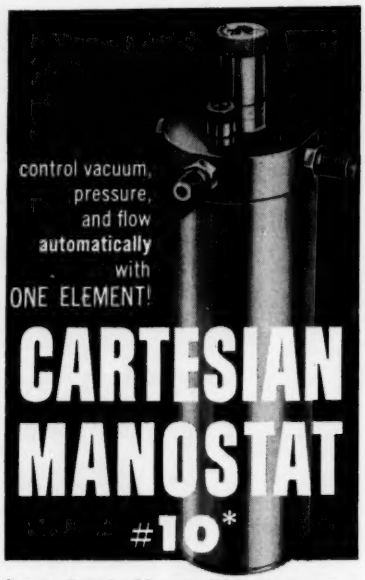
GE Apparatus Sales Div
Hastings-Raydist
Hays Corporation
Helicoid Gage Div
Heise Bourdon Tube
Hill & Co E Vernon
Hoke Inc
Industrial Instr Corp
International Register
Kunkle Valve Co
Manning Maxwell & Moore
Marsh Instr Co
Mason Neilan
M-H Brown Instrs Div
Marshalltown Mfg
Norwood Controls
Nurnberg Scientific
Panellit Inc
Powers Regulator
Reliance Instr Mfg
Rockwell Mfg Co
Sanborn Company
Scientific Instrument
Seegers Mfg
Solid State Electronics
Taylor Instrument
Uehling Instrument
Ultradyne Inc
US Gauge Div
Victor Equipment
Weksler Instruments
Weston Instruments

PRESSURE INDICATORS, Electrical Resistance

Baldwin-Lima-Hamilton
BJ Electronics
Gilmore Industries
Gulton Industries
Edison Industries T A
Hagan Chem & Controls
Hydel Inc
InstruLab Inc
Lewis Engrg Co
Manning Maxwell & Moore
Model Engrg
Norwood Controls
Panellit Inc
Rahm Instruments Div
Servonic Instruments
Swartwout Co
Taber Instrument
Thermo Electric
Trans-Sonics
Weston Instruments
Westronics Inc

PRESSURE INDICATORS and/or RECORDERS, High (Above 1000 psi) Pressure

Acme Gauge & Instr
American Meter Co
Automatic Timing & Contls
Bailey Meter Co
Barber-Colman

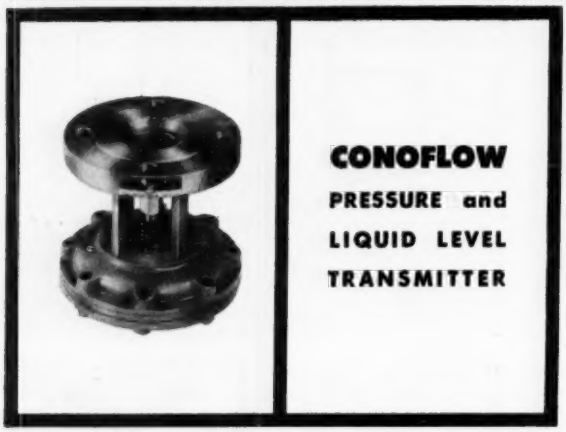


Put the Cartesian Manostat #10 in your system—set it and forget it! Self-contained unit operates automatically, economically, accurately!
Interchangeable balanced orifice (choice of 5/16", 3/8", or .070") preserves sensitivity at high capacity, permits direct or reverse action in same instrument.
Cartesian Manostat #10 complete and ready for use, with mercury. **$450.00**

WRITE FOR COMPLETE DESCRIPTIVE BULLETIN

HOKE, MANOSTAT CORP.
26 N. Moore Street • Dept 17
New York 13, N.Y.
*Patent Applied For

CIRCLE 68 ON READER-SERVICE CARD



CONOFLOW PRESSURE and LIQUID LEVEL TRANSMITTER

The Conoflow Model "P" Transmitter is a rugged instrument capable of measuring pressure or liquid level, and transmitting a *linear* 3-15 psi signal to a suitable recorder. No dip tubes, floats, or other mechanical devices are required inside the tank. Can be used for many services, on either open or closed vessels. Ideal for viscous fluids or materials which solidify in the static lines of pressure elements of conventional transmitters.

Available for measuring ranges from as low as 0 to 100" of water or pressures as high as 250 psi. Utilizes a corrosion-resistant Inconel X diaphragm suitable for temperatures to 450° F. Measured material cannot penetrate air lines. Safety shut-off feature available. Ranges easily changed in the field.

Write for Bulletin P-2520-3, today. CC714

Conoflow Controls FOREMOST IN FINAL CONTROL ELEMENTS

CONOFLOW CORPORATION
SUBSIDIARY OF WALWORTH COMPANY
2100 ARCH STREET • PHILADELPHIA 3, PA.

CIRCLE 67 ON READER-SERVICE CARD

THE CALIBRATING STANDARD
...For Absolute Pressure Work

Ranges: 0-31.5 inches thru 0-100 inches of Hg. absolute in five ranges—45 inch scale in two revolutions.

Accuracy: 1/1000 of full scale

Sensitivity: 1/10,000 in *all* ranges

Write for Publication No. A-114.48-A

WALLACE & TIERNAN
INCORPORATED
25 MAIN ST., BELLEVILLE 9, N. J.
In Canada: Wallace & Tiernan, Ltd., Toronto
A 114

CIRCLE 69 ON READER-SERVICE CARD

PRECISE
ABSOLUTE PRESSURE

TYPE FA-160

From 200 Microns Up

...Ranges: 0—50 mm thru 800 mm Hg absolute in six ranges.
...Accuracy: 1 part in 300 over full scale.
...Sensitivity: 1 part in 500 in *all* ranges.
...Available with 2¾" or 6" dia. dial.

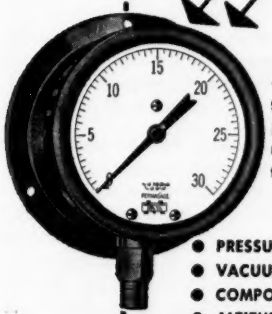
Write for Publication No. A-105-r.48-A

WALLACE & TIERNAN
INCORPORATED
25 MAIN ST., BELLEVILLE 9, N. J.
In Canada: Wallace & Tiernan, Ltd., Toronto

CIRCLE 70 ON READER-SERVICE CARD

MARSHALLTOWN

THE RIGHT GAUGE FOR YOUR SPECIFIC NEEDS



Available in a wide variety of general purpose and special purpose gauges in pressure ranges to meet your specifications in every particular.

- PRESSURE
- VACUUM
- COMPOUND
- ALTITUDE
- COMBINATION
- DIAPHRAGM
- HYDRAULIC
- AND SPECIAL PURPOSE GAUGES
- DIAL THERMOMETERS (Vapor Tension or Bi-Metal)

WRITE TODAY FOR COMPLETE INFORMATION

MARSHALLTOWN MFG. COMPANY
MARSHALLTOWN 3, IOWA

CIRCLE 71 ON READER-SERVICE CARD

STRAIN GAUGE INSTRUMENTATION
for measurement of:

PRESSURE
FORCE
DISPLACEMENT
FLOW

DYNISCO designs and manufactures a complete line of quality miniature pressure transducers with full scale pressure ratings from 0.1 to 50,000 psi and operable in a temperature range of −65 to +300°F. Models available to 500°F, and water cooled units for hot gaseous media up to 6000°F.

Whatever your requirement there's a model to fit your needs. DYNISCO's transducers incorporate:

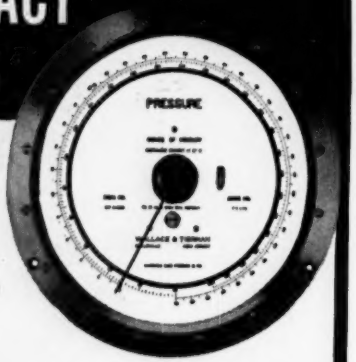
- All-welded stainless steel construction for use in corrosive media
- Linearity of ½ percent (based on straight line thru end points)
- Low temperature effect on sensitivity (as low as 1/100 percent/FS/deg F)
- Low hysteresis (less than ¼ percent of FS output)
- Generous overload protection
- All transducers are high-temperature tested at 300°F.

Catalog available on request. For further information regarding your specific application write to:

DYNAMIC INSTRUMENT CO., INC.
42 CARLETON STREET CAMBRIDGE 42, MASS.

CIRCLE 72 ON READER-SERVICE CARD

PRESSURE Measurement ACCURACY 0.1%



W&T PRECISION DIAL MANOMETER, FA-145

Ranges: **All ranges from 0-120 inches water through 0-300 inches Hg. in two revolutions — 45 inch scale.**

Write today for Publication No. A-96-r.48-A

WALLACE & TIERNAN
INCORPORATED
25 MAIN ST., BELLEVILLE 9, N. J.
In Canada: Wallace & Tiernan, Ltd., Toronto

CIRCLE 73 ON READER-SERVICE CARD

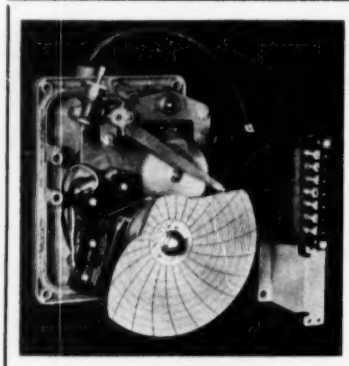
Barton Instrument
BJ Electronics
Bristol Co
Crosby-Ashton
Daytronic Corp
Defender Instrument
Detroit Controls
Dickson Co
Electric Auto-Lite
Enterline-Angus
Exactel Instrument
Fischer & Porter Co
Foxboro Company
Gilmore Industries
Gulton Industries
Hagan Chem & Controls
Hastings-Raydist
Hays Corporation
Heise Bourdon Tube
Helicoid Gage Div
Industrial Instr Corp
InstruLab Inc
Kistler Instrument
Manning Maxwell & Moore
Marsh Instr Co
Mason Neilan
M-H Brown Instrs Div
Norwood Controls
Pneumercator Co
Rahm Instruments Div
Scientific Instrument
Scientific Products
Seegers Mfg
Servonic Instruments
Swartwout Co
Taylor Instrument
Thermo Electric
Trans-Sonics
Ultradyne Inc
U S Gauge Div
Victor Equipment
Weksler Instruments
Weston Instruments
Westronics Inc

PRESSURE INDICATORS, Peak, including Blast Meters

Allegany Instrument
Atlantic Research
Gilmore Industries
Hagan Chem & Controls
Hydel Inc
Kistler Instrument
Norwood Controls
Ultradyne Inc
U S Gauge Div

PRESSURE INDICATORS, Precision, including large dial

Acme Gauge & Instr
Automatic Timing & Contls
Baldwin-Lima-Hamilton
Bendix Montrose Div



BAILEY PROGRAM CONTROLLER

● Positions a pneumatic transmitter in accordance with time/amplitude function of a 6-inch diameter cam. This establishes a pneumatic signal which is used as a set point signal to adjust an external control relay.

The "plug-in" Program Controller and its pneumatic transmitter may be installed in the same case with one or two electronic or pneumatic receivers.

The Bailey Program Controller also drives a recording pen to record the cam program for comparison on the same chart with the controlled variable.

Request Product Specification E99-6

BAILEY METER COMPANY
1081 IVANHOE ROAD CLEVELAND 0

CIRCLE 74 ON READER-SERVICE CARD

HAGAN PRESSURE TRANSDUCER

The Hagan Model A-2 Transducer is a current feedback, torque balance pressure transducer with low drift characteristics and high speed. The A-2 is designed for use in precision electronic control systems or in single or multiple readout systems. With a companion amplifier, the A-2 produces a DC signal of 3 to 28V or 0 to 25V directly proportional to the input pressure. Ideal for use with data processing systems.

HAGAN CHEMICALS & CONTROLS, INC.
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Flumendosa No. 13, Milano, Italy

CIRCLE 75 ON READER-SERVICE CARD

FROM SERVONIC...
A complete line of Transducers for Rugged Applications

Model H—High Pressure Transducers: For highly accurate measurement of pressure in corrosive fluids while exposed to extreme environments. Sealed, oil-filled cases available in most models. 400 to 8,000 psi. Vibrations to 30g. Various case configurations readily available. Write for Bulletin SI-581.

Model H-90

Model G-76

Model L-44

Model G—Rectilinear Potentiometers: For measuring displacement of missile and aircraft. actuators. Can be mounted internally or externally. Vibration levels to 35g. Ranges from 1/8" to 12". Critical elements of this high performance potentiometer are humidity sealed within a high-strength alloy case.

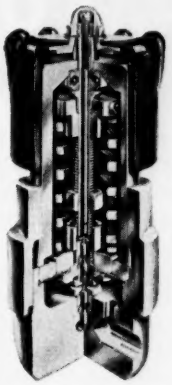
Model L—Low Pressure Transducers: Rugged, high response instrument. Pressure actuated, corrosion resistant aneroid elements operate precision potentiometer. Switching function can be accomplished in lieu of potentiometer output. Working fluids excluded from sealed oil-filled case. Send for Bulletin SI-582.

Special designs to your specifications.

SERVONIC INSTRUMENTS, INC.
640 Terminal Way, Costa Mesa, California

CIRCLE 76 ON READER-SERVICE CARD

GROVE SMALL VOLUME HIGH PRESSURE REGULATORS

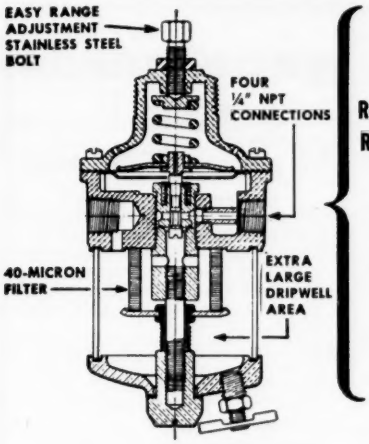


For accurate control of air, gas, liquid

Designed for reducing, back pressure and direct operating relief, or various combinations of these services. Inlet pressure ratings to 10,000 psi. Control pressure range from 0 to 6,000 psi on reducing and back pressure service, and up to 10,000 psi on relief service. Write for complete information.

GROVE VALVE AND REGULATOR COMPANY
65th & Hollis Streets, Oakland 8, California

CIRCLE 77 ON READER-SERVICE CARD



REDUCING-RELIEF TYPE REGULATOR COMBINED WITH AIR FILTER in CONOFLOW AIRPAK

Insures a dependable source of filtered, regulated air for use with pneumatic controllers and other equipment. Provides highly accurate pressure regulation, regardless of wide variations in flow and upstream pressures. Made of chemically treated corrosion-resistant aluminum and stainless steel. Filter medium quickly cleaned by loosening only one bolt. Your best buy for easy installation and maintenance, rugged service, long life. Available in a variety of ranges and dripwell capacities.

Conoflow Controls FOREMOST IN FINAL CONTROL ELEMENTS

WRITE FOR BULLETIN H-2-PD

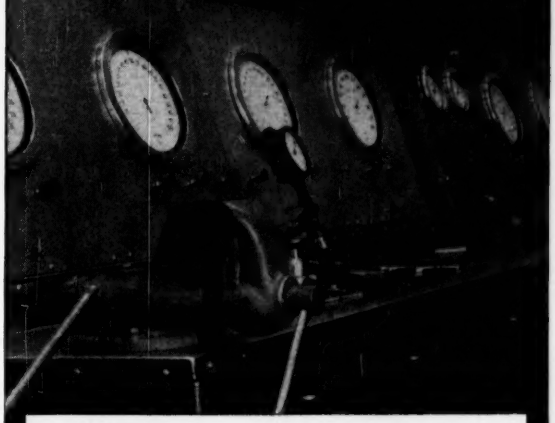
CC718

CONOFLOW CORPORATION
SUBSIDIARY OF WALWORTH COMPANY
2100 ARCH STREET • PHILADELPHIA 3, PA.

CIRCLE 78 ON READER-SERVICE CARD

ACRAGAGE®

sets the standard!



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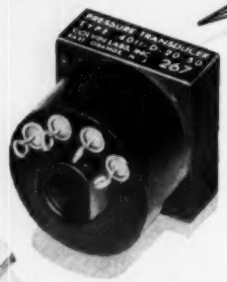

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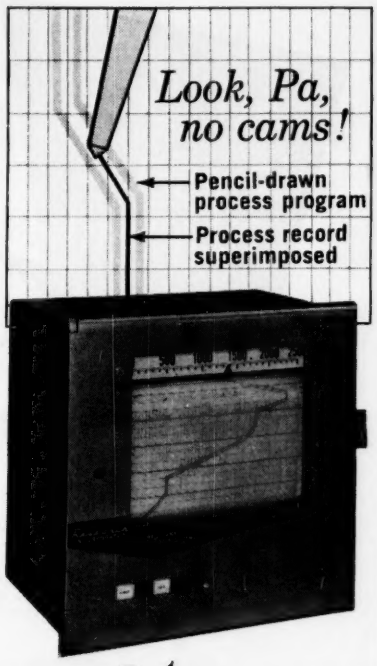

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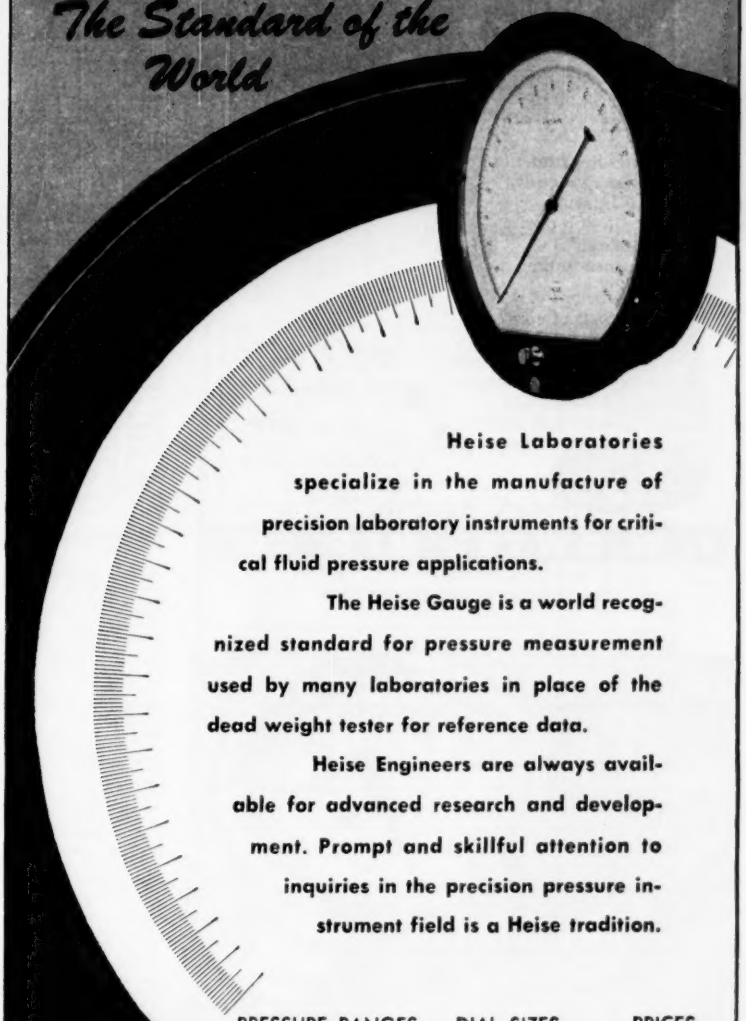

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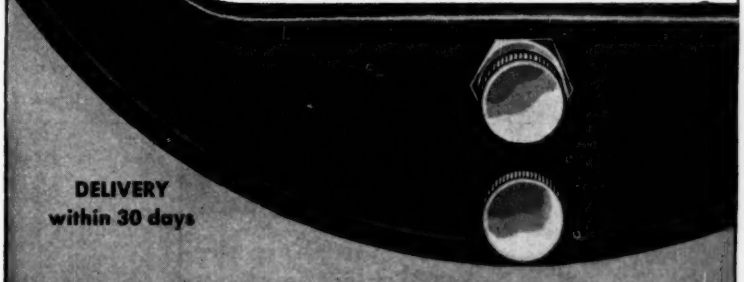

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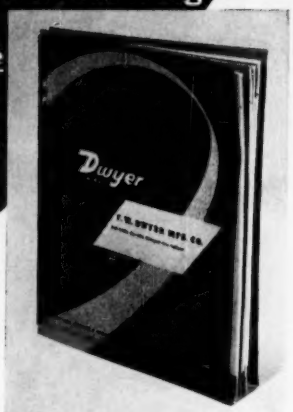

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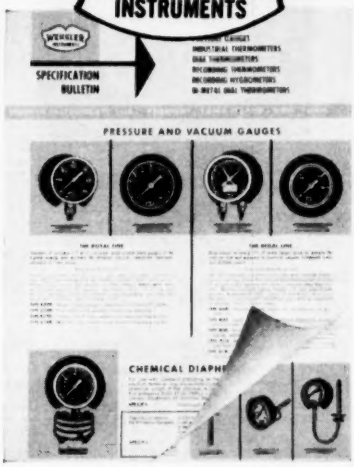

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Designed for "at a glance" information and specifications on Weksler instruments most frequently specified for indicating and recording temperature, pressure and humidity, the bulletin illustrates and describes most of the basic instruments needed in air-conditioning, heating, ventilating, plumbing and piping.

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Determines temperatures of minute spots, fast-moving objects and smallest streams—at a glance! No correction charts or accessories needed. Easy to use—weighs only 3 lbs. Special types available to show true spout and pouring temperatures of molten ferrous metal measured in open. Five stock ranges from 1400° F. to 7700° F.

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Surface Pyrometer

The ideal instrument for all plant and laboratory surface and sub-surface temperature measurements. Available with large selection of thermocouples and extension arms for all jobs. Designed for ruggedness and accuracy . . . it features automatic cold end compensation, large 4¾" direct reading dial and shock, moisture and dust-proofed shielded steel housing. 5 stock ranges 0-300°F. to 0-1200°F.

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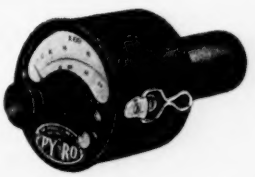

Tells spot temperatures instantly in heat-treating furnaces, kilns forgings and fire boxes. No thermocouples, lead wires or accessories needed! Temperature indicated on direct reading dial at a press of the button. Any operator can use it. Two double-ranges from 1000° F. to 3400° F.

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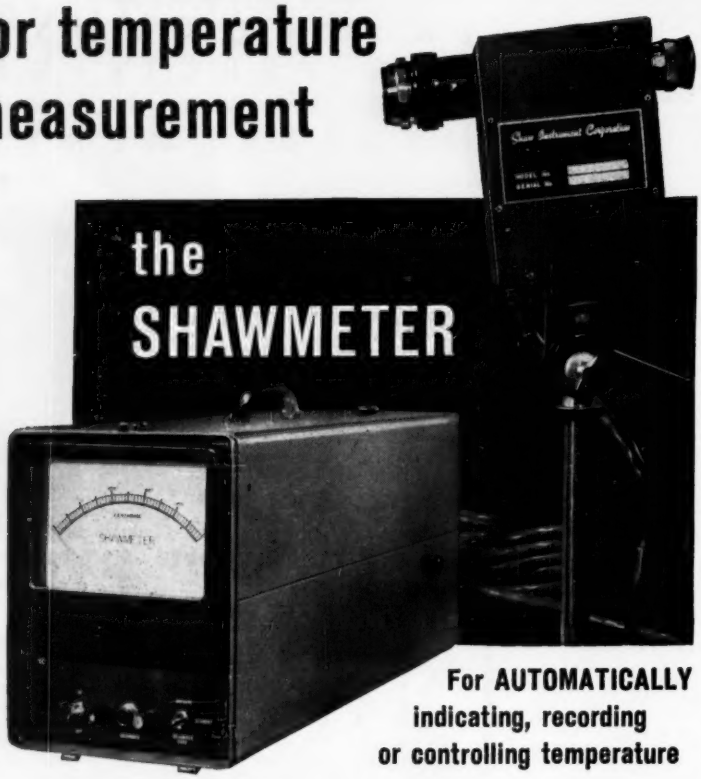
Manufacturers of PYRO Optical, MICRO-OPTICAL, SURFACE, RADIATION, IMMERSION and INDICATING PYROMETERS for over 25 years. Catalogs on request.

CIRCLE 90 ON READER-SERVICE CARD

A new type instrument for temperature measurement



For AUTOMATICALLY indicating, recording or controlling temperature

NOT a radiation pyrometer
NOT an optical pyrometer

Employing a unique principle that eliminates the shortcomings of previous instruments, the Shawmeter provides an easy, continuous, automatic method of measuring the temperature of flowing molten metal, moving objects in a kiln or furnace, lamp filaments, induction heating coils or other high temperature objects.

The Shawmeter consists of two units: the Sensing Head which responds to the color of the object being measured; and the Control Unit, which converts the information into a direct-reading linear temperature measurement. The Sensing Head may be as close to the object as a few inches, or it may be several hundred feet away. The Control Unit may be placed wherever convenient. Portable style is shown above.

Write for complete details and prices.

SHAW INSTRUMENT CORP.
P. O. Box E-46 Latrobe, Pennsylvania

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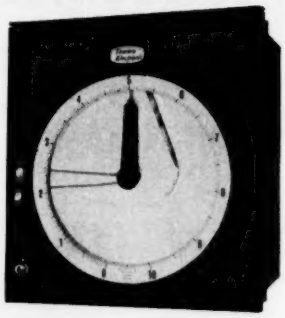
PYROMETERS

T-E has combined advanced design with quality performance in a wide variety of pyrometric instruments.



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Indicators
Self-balancing, potentiometer, bridge, millivoltmeter.

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Recorders
Circular chart indicating and controlling.

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"AutoRef"—providing multiple circuit cold-junction compensation
Temperature Monitoring Systems

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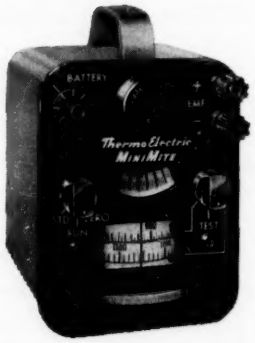
MINIMITE

PORTABLE INDICATOR
Null Balance, Potentiometer Type



This compact unit weighs under 4 lbs.—yet it has a 23½ inch double range scale. It can measure temperatures directly, when connected to a thermocouple, or calibrate other potentiometer or millivoltmeter-type instruments. Available scales cover temperatures from —300°F. to +3200°F. for all standard T/C materials; millivolt ranges from 0 to 62. Accurate to ¼ of 1% of scale range.

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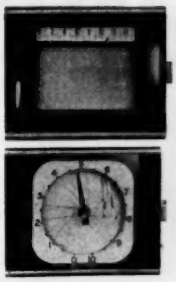
Potentiometers, Electronic, Round and Strip Chart



Bristol Electronic Dynamaster (R) Potentiometers will measure, record, or automatically control any variable that can be translated into an electrical quantity (d-c current, d-c voltage, capacitance, or resistance).

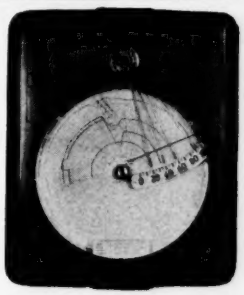
Offered in indicating, recording (up to 24 records on same chart), and controlling. All types of control: air operated, electric, electronic program control.

Write for Bulletin P1245A

BRISTOL COMPANY

112 Bristol Rd., Waterbury 20, Conn.

CIRCLE 93 ON READER-SERVICE CARD



BAILEY

Electronic Pyrometer

• This indicating, recording, and controlling Bailey d-c PYROTRON Receiver Recorder is a self-balancing potentiometer which records one to four continuous temperature records on a 12 in. circular chart. It may be furnished with pneumatic or electric control. A themocouple or a radiation unit is the temperature sensitive element.

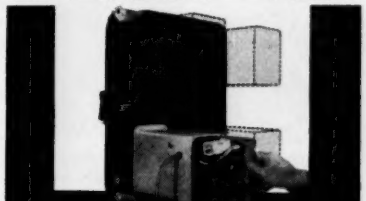
Minimum maintenance is assured by the elimination of galvanometers, millivolt meters, batteries and standard cells. A reversible electric motor, under electronic control, balances the potentiometer circuit and drives the indicating, recording, and controlling features.

Bailey PYROTRON Receiver Recorders are made up of interchangeable "plug-in" assemblies, standardized so that only a few spare parts need be carried in stock for many instruments.

Request Product Specifications E12-5 and E12-4

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O.
Bailey Meter Company Ltd. Montreal, Canada

CIRCLE 94 ON READER-SERVICE CARD



HAGAN ELECTRONIC RECEIVERS

For remote recording and/or control of temperatures, or the telemetering of flows, levels and pressures, the Hagan PowrLog instruments offer:

• Thermocouple or Resistance Bulb temperature measurements.
• Unique amplifier used for *all* types of measurements.
• Plug-in input boxes for each application.
• Fast and accurate, up to four variables may be recorded on one chart.

HAGAN CHEMICALS & CONTROLS, INC.
DIVISIONS: CALGON COMPANY, HALL LABORATORIES

HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Plumendosa No. 13, Milano, Italy

CIRCLE 95 ON READER SERVICE CARD

Printed Circuitry

by Allan Lytel. A valuable working tool; includes alternative and recommended practice for each step in design and production of printed circuits; a buyer's guide to special components; and "how to" service data. Paperboard, illustrated, 192 pages, 1957. **$2.00**

Electronic Circuitry for Instruments and Equipment

by M. T. Aronson. "Comprehensive source book on instrument circuitry," this complete home-study text includes 458 multiple-choice questions (and answers), 215 illustrations, 10 tables, comprehensive index. Paperbound, 324 pages, 1957 (revised edition). **$2.00**

100 Electronic Circuits

by M. H. Aronson and C. F. Kezer . . . covers amplifiers, oscillators, pulse circuits, phase shifters, etc. Complete with all circuit component values and response specifications. Paper, 180 pages, 1957. **$2.00**

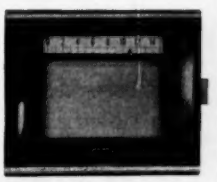
INSTRUMENTS PUBLISHING CO.
845 RIDGE AVENUE
PITTSBURGH 12, PENNA.

Pyrometers, Automatic Controllers, Indicators, Recorders

The Bristol line of Pyrometers includes electronic potentiometer, millivoltmeter, thermocouple, and radiation types in indicating, single-pen, two pen, and multiple record (up to 24) models.

Strip-and round-chart recorders and automatic controllers are available with any of the following types of control: electric, electronic, or air-operated with all types of control actions and as program controllers.

Write for Bulletins P1245A, P1242, P1244, P1248, and P1238.



Bristol Dynamaster (R) Electronic Potentiometer

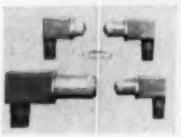
BRISTOL COMPANY

112 Bristol Rd., Waterbury 20, Conn.

CIRCLE 96 ON READER-SERVICE CARD

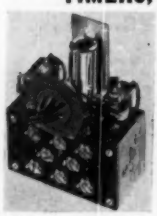
AUTOMATION COMPONENTS

PHOTOELECTRIC SCANNERS, MINIATURE



Small scanning heads for short and medium range (up to 12 feet). High-precision scanning of rapidly moving parts. Write for Bulletin.

TIMERS, ELECTRONIC

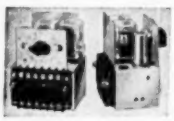


CK Timers use Type 5823 cold-cathode tube that provides instant starting with no tube warmup, immediate recycling, and long tube life. 8-ampere contacts on all models.

Economy Models A, B, C, D, are furnished with choice of six time ranges,—full-scale range of 0.2, 0.5, 1.5, 3, 6, 12, or 24 seconds. Small size—4¾" × 3⅞" × 2".

Model 3 Repeat-cycle Timer has independent adjustment of ON and OFF cycles, plug-in relays; is totally enclosed. Size 5" × 4¼" × 3¾".

Model 120 General Purpose Timer features plastic-enclosed plug-in relays, seven basic modes of operation, including repeat-cycle timing. Size 4⅞" × 3¾" × 3½".



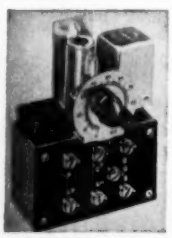
Model 2 Voltage-regulated Timer—Timed interval varies less than 2% of full scale for line voltage change between 95 and 125 volts.

SYNCHRONOUS CONTACTORS

Rotating camshaft actuates distributor-type switches to control punch presses, computors, and machine tools; protects looms, punch and die tools. Single- and double-circuit models available. Bulletin on request.

RELAY, ELECTRONIC

Operated by high-speed low-energy impulses the Type CK electronic relay picks up impulses too small to operate a mechanical relay directly and holds the circuit closed long enough to actuate heavy equipment. Size: 3⅞" × 4⅞" × 3".



FARMER ELECTRIC

Control Company, Incorporated

2300 WASHINGTON ST. NEWTON LOWER FALLS, MASS

CIRCLE 97 ON READER-SERVICE CARD

Bulova Research
Di/An Controls
Electric Tachometer
Electro Instruments
Engineered Electronics
Epic Inc
Federal Pacific
Fischer & Porter Co
Foxboro Company
GE Apparatus Sales Div
GPE Controls
Gulton Industries
Hagan Chem & Controls
Hays Corporation
Healy-Ruff Co
Houston Instrument
Instrol Inc
Larson Instrument
Leach Corporation
Leeds & Northrup
MacLaren & Co F B
Manning Maxwell & Moore Mass Div
M-H Brown Instrs Div
North Electric Co
Norwood Controls
Poole Instrs Inc
Precision Mechanisms Corp
Sanborn Company
Scientific Instrument
Swartwout Co
Taylor Instrument
Times Facsimile
Warner & Swasey Co
West Instrument
Weston Instruments
Westronics Inc
Yarnall Waring

RECEIVER INDICATORS, and RECORDERS, Pneumatic Signal

American Meter Co
Applied Science Corp
Bailey Meter Co
B-I-F Industries
Bristol Co
Crosby-Ashton
Dickson Co
Ellison Draft Gage
Fischer & Porter Co
Foxboro Company
GE Apparatus Sales Div
Hagan Chem & Controls
Hays Corporation
Johnson Service Co
Kieley & Mueller
Mason Neilan
M-H Brown Instrs Div
Moore Products Co
Powers Regulator
Scientific Instrument
Taylor Instrument
US Gauge Div
Weston Instruments

REFRIGERATION CONTROLLERS

Atkins Technical Inc
Bristol Co
Controls Co of Amer
General Controls
Haydon Co A W
Partlow Corp
Scientific Instrument
United Electric Controls
Weston Instruments

SCANNERS

Anadex Instruments Inc
Appalachian Electronic
Applied Science Corp
Assembly Products Inc
Baldwin-Lima-Hamilton
Cunningham Son & Co
Datex Corp
Designers for Industry
Electric Eye Equip
Engis Equipment
Erie Pacific
Foxboro Company
GPE Controls
Geotechnical Corp
Gilmore Industries
Gordon Enterprises
Illinois Testing Labs
Lind Corp
Maxson Corp W L
Paraban Inc
Philco Corp
Photobell Co
Powers Regulator
Radiation Electronics
Thermo Electric
Times Facsimile
United Aircraft Prods

SERVO VALVES, Hydraulic

Acme Industrial Co
Amer Meas & Control
Automatic Timing & Con'ls
Cash Valve Mfg
Defender Instrument
Eastern Industries
GPE Controls
General Controls
Hydraulic Controls Co
Hydromatics Inc
Kearfott Co
Leonard Inc Wallace O
Midwestern Instrs
M-H Aeronautical Div
Model Engrg
Moog Servocontrols
North American Mfg
Oilgear Co
Standard Controls Inc
Sterling Precision
Vickers—A & E Center
United Aircraft Prods
Weston Hydraulics Ltd

SIGHT FLOW BUBBLERS

Acme Industrial Co
King Engrg
Petrometer Corp

SMOKE DENSITY INDICATORS and/or RECORDERS

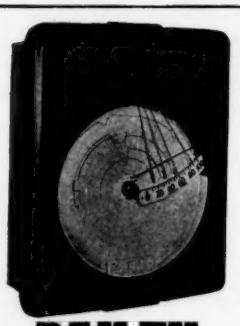
Bacharach Indus Instr
Bailey Meter Co
Bristol Co
Diamond Power Specialty
GE Apparatus Sales Div
Hays Corporation
Hoffman Electronics
Instr Development Labs
Leeds & Northrup
Phoenix Precision Instr
Photobell Co
Photomation Inc
Reliance Instr Mfg
Research Appliance Co
Westronics Inc
Worner Electronic Devices

SPECIFIC GRAVITY CONTROLLERS, INDICATING AND RECORDERS

Accuracy Scientific
Alfa-American Corp
American Meter Co
Automation Products
Burton Instrument
Brooks Rotameter
Dwyer Mfg F W
Federal Pacific
Fischer & Porter Co
Foxboro Company
Hagan Chem & Controls
Hallikainen Instrs
Houston Instrument
Impact-O-Graph Corp
Industrial Nucleonics
Instrumen's Inc
Kieley & Mueller
King Engrg
M-H Brown Instrs Div
Moore Products Co
Norwood Controls
Ohmart Corp
Petrometer Corp
Poole Instrs Inc
Ranarex Div
Schutte and Koerting
Westronics Inc

SPEED INDICATORS, RECORDERS, and REGULATORS, including Speed Switches

Actuator Prods Corp
Airpax Electronics



BAILEY

RECEIVER RECORDER

• A Recorder and/or Controller for pneumatic and electric transmission systems or for direct operating pressure units. Provides one to four continuous chart records on a single 12 in. circular chart.

"Plug-in", precalibrated units provide flexibility and permit easy field adaptation to revise application requirements. Clean, fresh, brilliant ink is fed to recording pens from sealed sacs which contain a normal one-year's supply.

The "plug-in" components available are:

Pneumatic Receiver
Integrator
A-C Electronic Receivers
D-C Electronic Receivers
Pilotrol
Pneumatic Transmitter
Electric Transmitter
Program Controller
Running Time Recorder
Direct Operating Pressure Recorders

Request Product Specification E12-5.

BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND, O
Bailey Meter Company Ltd. Montreal, Canada

CIRCLE 98 ON READER-SERVICE CARD

SMOKE INDICATORS AND RECORDERS

BAILEY METERS

BAILEY SMOKE DENSITY RECORDER (Bolometer Type)

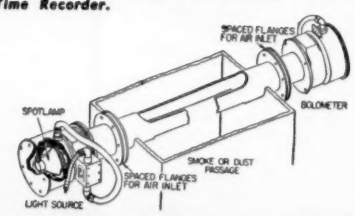
May also be used to indicate Dust Density or Particle Concentration.

The Bailey Smoke Density Recorder quickly reveals inefficient operating conditions and provides 24-hour continuous records. A Bailey Running Time Recorder may be included in the same case to record elapsed time of excessive smoke condition.

Both light source and Bolometer are of sealed beam construction to assure long, accurate life. This unique smoke detector is not affected by high ambient temperatures or corrosive gases. It needs no cooling devices.

Request Product Specification E66-1 for Smoke Density Recorder and Product Specification E12-5 for Running Time Recorder.

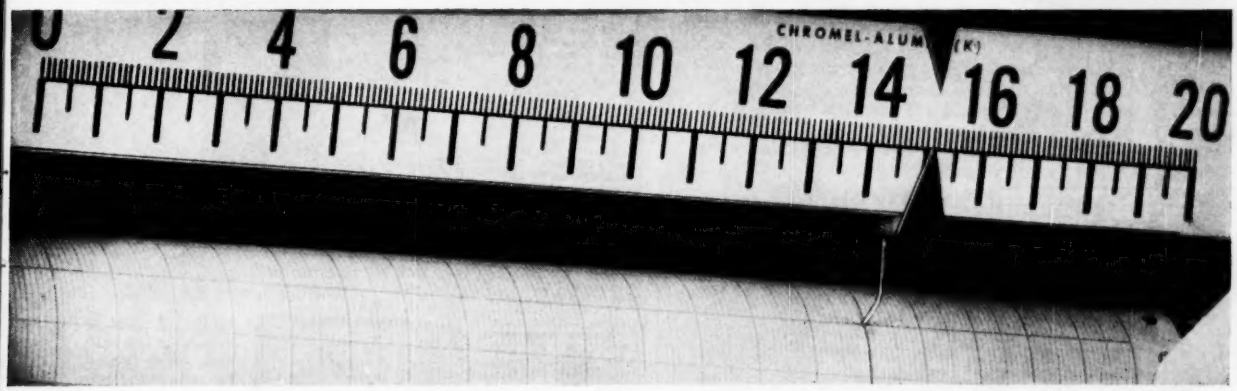
Smoke Density Recorder



BAILEY METER COMPANY
1041 IVANHOE ROAD · CLEVELAND 10, OHIO

CIRCLE 99 ON READER-SERVICE CARD

standardizes itself continuously . . .



This new General Electric Type HF recorder is continuously self-standardized. And it's typical of the new G-E null-balance strip-chart line. No more batteries, standard cells and standardizing mechanisms . . . new silicon diode voltage source now makes possible completely uninterrupted measurement and control—with measurement accuracy of ±¼ percent. ***Unitized plug-in construction*** provides simple design with isolation of components by function. All major components are mounted on swing-out mechanism panel for easy servicing outside case. Both single-pen Type HF and two-pen Type HL are available. Or, for an intermittent record of up to 20 different signals, G.E.'s new Type HG multi-point recorder prints as fast as 1.2 seconds per point. All types measure ***wide range of parameters . . .*** pen speeds from 1 to 24 seconds, chart speeds from 1″/hr to 360″/hr, plus many other optional accessories and a variety of control forms. Get the complete story about these and many other outstanding features. Just call your nearby G-E Apparatus Sales Engineer, or write for bulletin GEA-6887, Section 595-102, General Electric Company, Schenectady, N. Y.

Other Instrument Department Recorders for Electric Utilities— *Inking and inkless; portable and switchboard; duplex and twin; hook-on recording volt-ammeters. Photoelectrics, oscillographs and vibrometers.*

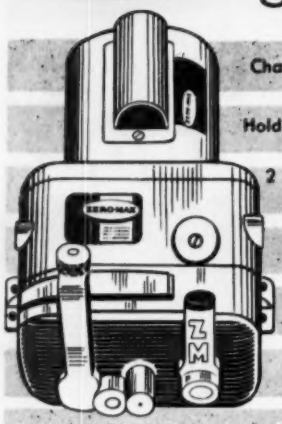
Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 100 ON READER-SERVICE CARD

ZERO-MAX

STEPLESS VARIABLE SPEED



Change speed fast . . . anytime

Holds and re-sets speed accurately

2 to 450 in.—lb. torque ratings (fractional H.P.)

Zero to 2,000 RPM

Full range forward and reverse

Lever, screw or remote controls

LOW COST—ideal for original equipment

ZERO-MAX stepless variable speed drives are available with or without reverse, gearheads or motors—list price from $37.00 Consult our engineers or write for our free 16-page catalog.

THE ZERO-MAX COMPANY

Subsidiary of Revco Inc.
1938 Lyndale Ave. S., Minneapolis 5, Minn.
Phone: FR 4-5520

CIRCLE 101 ON READER-SERVICE CARD

Allen-Bradley
American Meter Co
Annin Company
Bailey Meter Co
Barber-Colman
Bin-Dicator Co
Bowmar Instrument
Bristol Co
CGS Laboratories Inc
Control Technology
Detroit Controls
Electric Regulator
Electric Tachometer
Electro Products Labs
Engler Instr
Epic Inc
Esterline-Angus
Federal Pacific
Foxboro Company
GE Apparatus Sales Div
General Radio
Hanson-Gorrill-Brian
Hays Corporation
Hewlett-Packard
Kahn & Co
Leeds & Northrup
Machinery Electrification
MacLaren & Co F B
Marx Co Clarence J
Metron Instrument
Micrometrical Mfg
M-H Brown Instrs Div
North Atlantic Indus
Norwood Controls
Performance Measurements
Photobell Co
Scherr Co George
Servonic Instruments
Soyeheu-Start
Specialties Inc
Stiebt Co Herman
Sterling Precision
Stratos Div
Tapco Group
Taylor Instrument
Thermo Electric
Universal Match
Uniwave Inc
Vectrol Engrg
Vickers Electric Prods Div
Westburg Mfg Co
Westinghouse Electric
Weston Instruments
Westronics Inc
Zernickow Co O

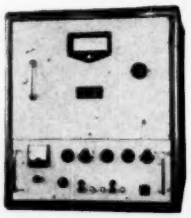
SPEED REDUCERS and SPEED INCREASERS

Actuator Prods Corp
Allis-Chalmers
Annin Company
Bowmar Instrument
Cleveland Worm & Gear
Dalmotor Div
FAE Instrument
Feedback Controls Inc.
GE Apparatus Sales Div
Insco Company

STRAIN INDICATORS

DR-20 A basic strain indicator for use with all types of strain gages. Extremely wide calibration range (gage factor ½ to 10) makes the DR-20 ideally suited for use with all types of strain gage transducers.

Write for Bulletin 107



LC-261 A precise automatic null balance strain indicator with extremely wide range.

- Resolution: 0.005%
- Repeatability: 0.01%
- Linearity: 0.02%
- Accuracy: 0.05%

Write for Bulletin 105-A

BYTREX manufactures a complete line of strain gage equipment. Write for further information.

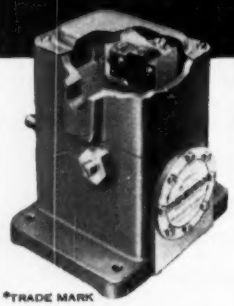
BYTREX

BYTREX CORPORATION
50 HUNT STREET • NEWTON 58, MASS.

CIRCLE 103 ON READER-SERVICE CARD

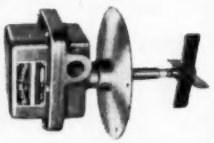
New ROTO-GUARD®

SHAFT MOTION INDICATOR



Provides positive indication of drop in speed or stopping of machinery. Protects conveyors, elevators, feeders, etc. Rugged, compact; connects to rotating shaft, actuates warning lights or other signals, operates control switches. Simple, positive, low cost. Write for Bulletin RG-16.

*TRADE MARK



ROTO-BIN-DICATOR® motor-driven, paddle-type bin level indicator for use on granular or pulverized material. Ideal for bins under vacuum or pressure. Automatically operates signals and controls.

BIN-DICATOR® diaphragm-type bin level indicator. Successful for 20 years. Automatically operates signals and controls.

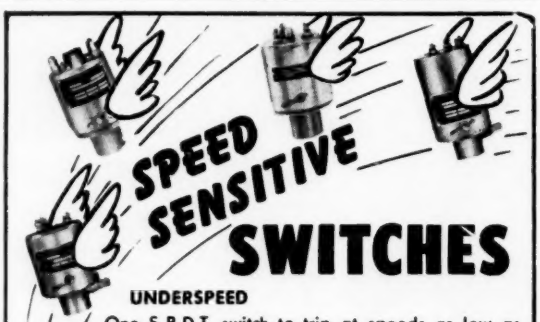
BIN-FLO® uses small volume, low pressure air to keep bulk materials moving in chutes, bins, hoppers. No moving parts. Simple installation.

THE BIN-DICATOR CO.
13946-B4 Kercheval • Detroit 15, Mich.

Write for free copy of catalog BD-15 or call VAlley 2-6952

WE SELL DIRECT • PHONE ORDERS COLLECT

CIRCLE 102 ON READER-SERVICE CARD



SPEED SENSITIVE SWITCHES

UNDERSPEED

One S.P.D.T. switch to trip at speeds as low as 400 RPM. Maximum operating speed 5,000 RPM.

OVERSPEED

One S.P.D.T. switch to trip at speeds between 500 and 6,000 RPM.

OVER and UNDERSPEED

Two S.P.D.T. switches to trip at two different speeds between 500 and 6,000 RPM.

OVER—INTERMEDIATE and UNDERSPEED

Three S.P.D.T. switches to trip at three different speeds between 1,200 and 6,000 RPM.

Speeds above or below those listed above must be referred to our Engineering Department for special consideration. Request Bulletin 504 describing our Speed Sensitive Switches.

SYNCHRO-START PRODUCTS
INCORPORATED
8151 N. RIDGEWAY AVENUE, SKOKIE, ILLINOIS
Automatic Engine Control Sets—Safety Alarm Sets—Special Control Panels—D. C. Solenoids—Heavy Duty Relays

CIRCLE 104 ON READER-SERVICE CARD

AMGLO STROBOSCOPIC TUBES

Amglo stroboscopic tubes are standard equipment in a wide variety of stroboscopic instruments, medical electronic units, automotive ignition timers, wheel balancing equipment and high speed photographic units.

A complete range of standard types are available, or special tubes to suit your specific requirements can be developed.

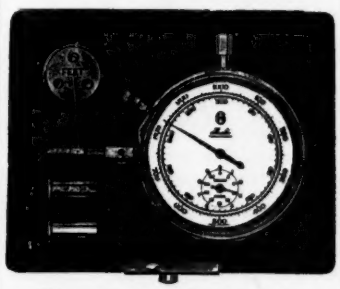
- 400 to 600 Volts
- For Electrolytic or Oil Type Capacitors
- Non-Polarized

Write For New Descriptive Circular!

AMGLO CORPORATION
4333 No. Ravenswood Ave.
Chicago 10, Ill.

CIRCLE 105 ON READER-SERVICE CARD

SPEED CONTROL with THE HASLER INDICATOR



Chronometric Tachometer with separate reset button for cumulative readings

DURABILITY: over 30 years

ACCURACY: ¼ of 1% of true speed through life

Type A 0-20,000 r.p.m. or 0- 6,000 f.p.m.
Type B 0- 2,000 r.p.m. or 0- 600 f.p.m.
Size 2¾" x ⅞" x 4" Spindle incl.
Weight 7¾ oz. ready for test

Shipment within 5 days from stock

HASLER—TEL CO., INC.
28 Vesey Street, New York 7, N. Y.
U.S. Distributors for Hasler Speed Indicators since 1919

CIRCLE 106 ON READER-SERVICE CARD

Jones Motrola
Link Aviation
Lovejoy Flex Coupling
Metron Instrument
Planet Instrument
Precision Mechanisms Corp
Reeves Pulley Co
Sterling Precision
Stratos Div
U S Electrical Motors
Uniwave Inc
Zero Max Co

SPEED SYNCHRONIZING INDICATORS
Airpax Electronics
Bowmar Instrument
Electric Tachometer
PIC Design Corp
Sterling Precision
US Electrical Motors
Uniwave Inc

STRAIGHTENING VANES
Bailey Meter Co
Bristol Co
Daniel Orifice Fitting
Foxboro Company
Robinson Orifice

STRAIN GAGES, including Bonded and Unbonded Resistance Type
Allegany Instrument
Baldwin-Lima-Hamilton
Bytrex Corp
Daytronic Corp
Dynamic Instr
Foxboro Company
Gulton Industries
High Temperature Instrs
Metzger & Son F F
Statham Instruments

STRAIN-RATE and STRESS-RATE CONTROLLERS
Baldwin-Lima-Hamilton
Bytrex Corp
GE Apparatus Sales Div
Research Inc
Westronics Inc

STRAIN-TIME RECORDERS
Allegany Instrument
Baldwin-Lima-Hamilton
B & F Instruments
Brush Instruments Div
Daytronic Corp
Electro Instruments
Ellis Associates
Geotechnical Corp
Gilmore Industries
Sanborn Company
Westronics Inc

STRESS-STRAIN ANALYZERS, INDICATORS and/or Controllers
Allegany Instrument
Anadex Instruments Inc
Baldwin-Lima-Hamilton
B & F Instrumen's
Boone Instrument
Brush Instruments Div
Bytrex Corp
Consol Electrodynamics
Consolidated Systems
Datran Electronics
Daytronic Corp
Ellis Associates
Gilmore Industries
Hewlett-Packard
Performance Measurements
Telechrome Mfg Corp
Westronics Inc

STROBOSCOPES
Berkshire Laboratories
Chadwick-Helmuth
Epic Inc
General Radio
Hickok Electrical Instr
Kemlite Labs
Sticht Co Herman

TACHOGRAPHS
Electric Tachometer
Engler Instr
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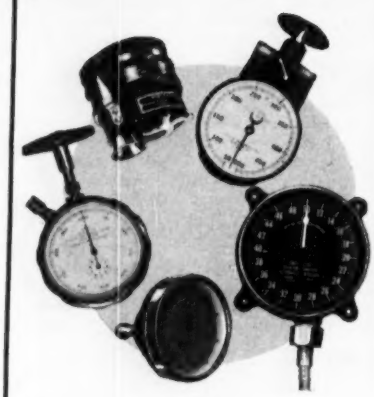

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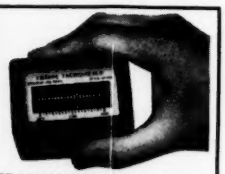

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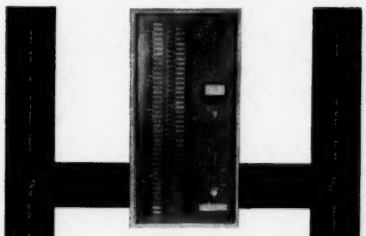

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- Continuous alarm scanning at the rate of 5 points per second.
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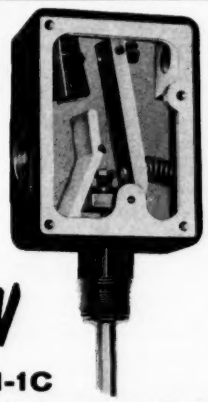

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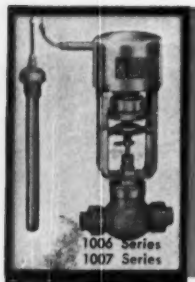

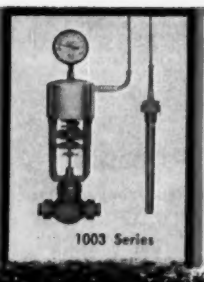

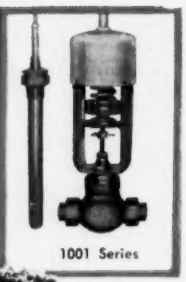

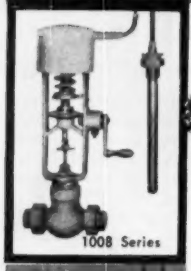

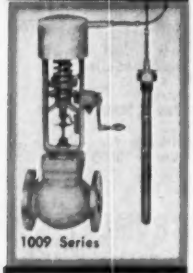

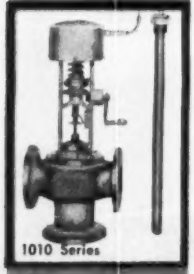

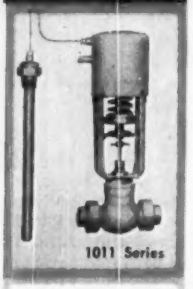

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16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	336	356	376	396	
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	337	357	377	397	
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	338	358	378	398	
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	339	359	379	399	
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	

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3	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	323	343	363	383	403
4	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	324	344	364	384	404
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	325	345	365	385	405
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	326	346	366	386	
7	27	47	67	87	107	127	147	167	187	207	227	247	267	287	307	327	347	367	387	
8	28	48	68	88	108	128	148	168	188	208	228	248	268	288	308	328	348	368	388	
9	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	329	349	369	389	
10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390	
11	31	51	71	91	111	131	151	171	191	211	231	251	271	291	311	331	351	371	391	
12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312	332	352	372	392	
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	353	373	393	
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	334	354	374	394	
15	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	335	355	375	395	
16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	336	356	376	396	
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19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	339	359	379	399	
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4	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	324	344	364	384	404
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	325	345	365	385	405
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	326	346	366	386	
7	27	47	67	87	107	127	147	167	187	207	227	247	267	287	307	327	347	367	387	
8	28	48	68	88	108	128	148	168	188	208	228	248	268	288	308	328	348	368	388	
9	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	329	349	369	389	
10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390	
11	31	51	71	91	111	131	151	171	191	211	231	251	271	291	311	331	351	371	391	
12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312	332	352	372	392	
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	353	373	393	
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Miniature **FAST-RESPONDING** Surface **THERMOCOUPLE**

New Design Features Offer for the First Time a Thermocouple with:

- A Response Time of Less than 10 Microseconds
- A Maximum Continuous Service Temperature of Over 2000°F.
- An Operating Pressure Range to 50,000 psi
- A Sensing Tip with unlimited Life

Revolutionary design uses thin ribbon thermocouple wires and mica insulation of .0002 inches thickness. Will operate under extremely high velocity and high pressure conditions.

Available in all standard thermocouple elements.

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Astra Technical Instr
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Bristol Co
Consol Controls
Engelhard Industries
Foxboro Company
Gordon Co Claud S
Harco Labs
High Temperature Instrs
Illinois Testing Labs
InstruLab Inc
Leeds & Northrup
Lewis Engrg Co
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Metals & Controls Div
M-H Brown Instrs Div
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Nanmac Corp
Pacific Transducer Corp
Pyro-Electric Inc
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Revere Corp of Amer
Richards Co Arklay S
Royco Instruments Inc
Slocomb Co J T
Smith Mfg Co Inc
Thermo Electric
Thermo Products Co
Trinity Equipment
West Instrument

THERMOCOUPLES, Contact Type (see also Thermometers Surface)

Aero Research Instr
Astra Technical Instr
Barber-Colman
Bristol Co
Conax Corp
Dyna-Empire Inc
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Get this new, free engineering handbook . . . on selection and application of thermocouples and pyrometer accessories

Complete, easy-to-use, 56-page compilation of Bristol's line of modern thermocouples and pyrometer accessories . . . tables of calibration data . . . PLUS illustrated catalog of the complete Bristol line of thermocouples, extension wire, protection tubes, insulators and accessories.

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Write for your free copy of this 56-page Pyrometer Guide.

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THERMOMETERS, —Recording and Automatic Controlling . . . for temperatures from —125F to +1000F

Bristol Series 500 Thermometers, the product of over 70 years of instrument-making experience, feature the latest developments in instrument engineering.

In manufacturing hundreds of thousands of recording and automatic controlling thermometers, The Bristol Company has developed a variety of models, sizes, and temperature ranges to fill every requirement.

Write for Bulletin T840.

BRISTOL COMPANY

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THERMOCOUPLES

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Copper-Constantan
Chromel-Constantan
Chromel-Alumel
Platinum-Rhodium-Platinum

GASKET
BAYONET
RIVET
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STAGNATION

Industrial Miniature thermocouples are made for use in chemical and oil refining processes, power plants, plastic molding, etc.—for any application requiring a small-size yet sensitive assembly.

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Copper-Constantan
Chromel-Constantan
Chromel-Alumel
Platinum-Rhodium-Platinum

Heavy Duty thermocouples for all industries and all applications. Accessories include a complete selection of extension wires, terminals, connection heads, quick-coupling connectors and fittings.

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Available in all commercial materials for all industries. Both built-up and bar stock.

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Saddle Brook, New Jersey

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Astra Technical Instr
Barber-Colman
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Conax Corp
Epic Inc
Foxboro Company
Gordon Co Claud S
Harco Labs
High Temperature Instrs
Illinois Testing Labs
InstruLab Inc
Leeds & Northrup
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McHugh & Son Raymond F
Metals & Controls Div
M-H Brown Instrs Div
Motech Co
Nanmac Corp
Pacific Transducer Corp
Pyro-Electric Inc
Pyro Service Co
Pyrometer Instr Co
Revere Corp of Amer
Richards Co Arklay S
Slocomb Co J T
Smith Mfg Co Inc
Thermo Electric
Thermo Products Co
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West Instrument

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Barber-Colman
Bristol Co
Epic Inc
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Gordon Co Claud S
Harco Labs
High Temperature Instrs
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THERMOMETERS, Dial, Bi-metal
Bacharach Indus Instr
Dillon & Co W C
Eastman Kodak
Fischer & Porter Co
Manning Maxwell & Moore
Marsh Instr Co
Marshall Instrs
Moeller Instr
Nurnberg Scientific
Pacific Transducer Corp
Palmer Thermometers
Powers Regulator
Precision Thermometer
Royco Instruments Inc
Taylor Instrument
Weksler Instruments
Weston Instruments

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Brinkmann & Co., C. A. Dickson Co
Dillon & Co W C
Electric Auto-Lite
Fischer & Porter Co
Foxboro Company
Green Instrs Henry J
Greiner Co Emil
Johnson Service Co
Manning Maxwell & Moore
Marsh Instr Co
Moeller Instr
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Nurnberg Scientific
Pacific Transducer Corp
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Partlow Corp
Philadelphia Scien Glass
Powers Regulator
Scientific Instrument
Seegers Mfg
Taylor Instrument
Tel-Tru Mfg
Testing Machines Inc
U S Gauge Div
Weksler Instruments
Weston Instruments

THERMOMETERS, Electrical Resistance, Indicating, Recording and/or Controlling
Aero Research Instr
Arnoux Corp
Astra Technical Instr
Atkins Technical Inc
Bacharach Indus Instr
Bailey Meter Co
Barber-Colman
Brinkmann & Co C A
Bristol Co
Edison Industries T A
Electric Auto-Lite
Fischer & Porter Co
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Hays Corporation

Thermophil
THERMISTOR THERMOMETERS

- **ACCURACY (of complete system): 1/3% to 2/3% of total Scale Range. Readability: .5 F° on 400 F° span instruments. .1 F° on 55 F° span instruments.**
- **SCALE LENGTH: 8-1/2" on three overlapping scales; 11-1/2" on four scale instruments.**
- **FASTEST RESPONSE: .7 sec. time constant in liquids; 2.2 sec. on surfaces.**
- **ONE HUNDRED INTERCHANGEABLE PROBES, TWENTY-SIX INSTRUMENTS, Readings between —148°F and +845°F or —100°C and +450°C.**
- **BATTERY or AC powered.**
- **STABLE EUROPEAN THERMISTOR resistance element, bridge circuit and amplifier.**

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Instrument as pictured, °F. or °C.
Temperature range; overlapping:

	Model # 4412F	Model # 4412C
Scale I	32° to 158°F	0° to 70°C
Scale II	158° to 284°F	70° to 140°C
Scale III	284° to 410°F	140° to 210°C

with one { # H10AO stainless steel for surfaces
probe, { # H01AF glass tipped for liquids
choice of { # H12AF stainless steel needle

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Minco Products
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Accuracy Scientific
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Bacharach Indus Instr
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Philadelphia Scien Glass
Precision Thermometer
Scientific Glass App
Scientific Instrument
Tagliabue Mfg Co
Taylor Instrument
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Weiss & Son Inc
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Barber-Colman
Bristol Co
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Rapid, accurate, low-cost, remote reading thermometer with many ranges and probes for medical, industrial and laboratory applications.

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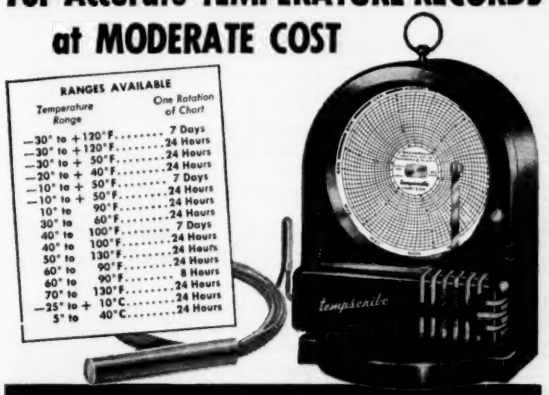
RANGES AVAILABLE
Temperature Range
One Rotation of Chart
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—30° to +120°F. 24 Hours
—30° to + 50°F. 24 Hours
—20° to + 40°F. 7 Days
—10° to + 50°F. 24 Hours
—10° to + 50°F. 24 Hours
10° to 90°F. 24 Hours
30° to 60°F. 7 Days
40° to 100°F. 24 Hours
40° to 100°F. 24 Hours
50° to 130°F. 24 Hours
60° to 90°F. 8 Hours
60° to 90°F. 24 Hours
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—25° to + 10°C. 24 Hours
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tempscribe

Use TEMPSCRIBE Recorders

BULB-TYPE (illustrated)—*For recording temperatures at a distance*
BI-METAL TYPE—*For recording temperatures in surrounding air*

- Portable—easily carried. Can be set on flat surface or hung on wall.
- Spring-wound instrument-type clock: 3 standard movements—8 hours, 24 hours or 7 days.
- Instrument measures 4½" x 5½" x 7½"; uses 4¼" diameter charts.
- Chart graduations easy-to-read; spaced uniformly over full range.
- Pen and its actuating components are in door. Doors are completely interchangeable to convert to any temperature range, or from bi-metal type to bulb-type.

Also available: (1) Interchangeable door with electro-magnetic armature to record running time of motors, burners, solenoid valves, etc. (2) Two-pen doors for recording temperature and electrical operation on same chart.

Write for Leaflets 786 and 872

BACHARACH INDUSTRIAL INSTRUMENT CO.
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U S Gauge Div
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Taylor Instrument
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Pacific Transducer Corp
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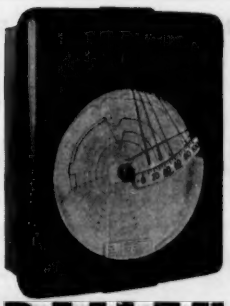

BAILEY
Resistance Thermometer

• Platinum resistance temperature element measures —400F to + 1200F; transmits to precalibrated "plug-in" type receivers in Bailey a-c PYROTRON Receiver Recorder.

One to four continuous temperature records are made on a single 12 in. circular chart. Each recording pen responds instantly since it is controlled by a separate inertia-free electronic detector. Each detector has its own power supply. A small reversible electric motor balances the a-c Wheatstone bridge circuit, and drives the indicating, recording, and controlling features. The Bailey a-c PYROTRON Receiver Recorder may be furnished with pneumatic or electrical control.

Any combination of electrically or pneumatically transmitted factors may be combined with temperature in the same recorder which features continuous, one-year, automatic inking.

Request Product Specification E12-5 for Receiver Recorder and E51-6 for Resistance Temperature Elements and Protecting Wells

BAILEY METER COMPANY
1041 IVANHOE ROAD CLEVELAND, O.
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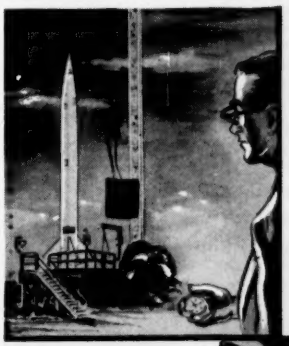

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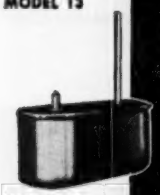
MODEL 13



MODEL 24

MODEL 11

For your precise applications:

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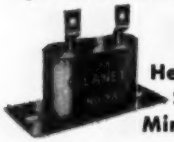
★ *Hermetically Sealed*

★ *Strain Relief Protected*

The quality of Ulanet miniature thermostats has been proved by years of dependable operation under the most extreme conditions. Their inherent accuracy and rapid response has been the leading reason for their final choice in so many critical applications. Get in touch with Ulanet for the answer to your heat control problems.



NEW!

Hermetically Sealed Surface-Sensing Miniature Thermostat

The only unit that meets the most stringent aircraft and military applications.

Send for Bulletin 100 for full details and dimensional drawings.

FM Series—The only metal thermostats that withstand mechanical clamping or pinching of cartridge without affecting set calibration.

FM Series

Write for Technical Data Sheets

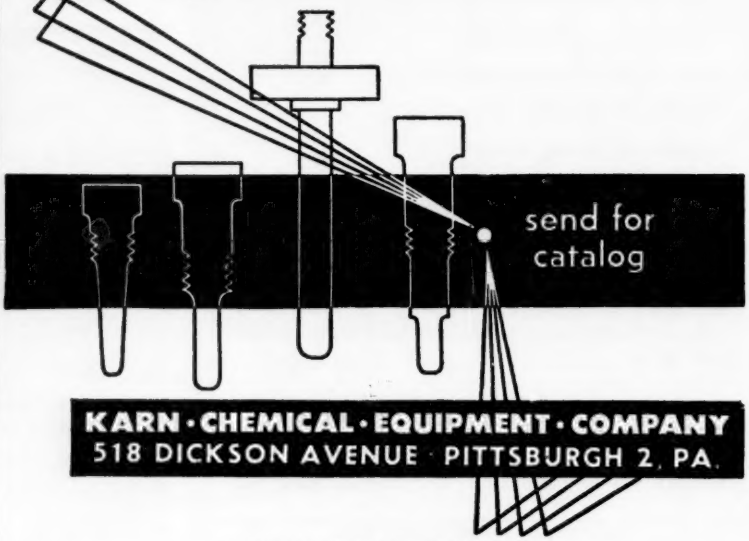
SINCE 1931 ULANET ELECTRIC HEAT CONTROL ENGINEERS

GEORGE ULANET COMPANY

419 Market St., Newark, N. J.

CIRCLE 129 ON READER-SERVICE CARD

KARN THERMOWELLS



KARN · CHEMICAL · EQUIPMENT · COMPANY

518 DICKSON AVENUE · PITTSBURGH 2, PA.

CIRCLE 130 ON READER-SERVICE CARD

Radiation Electronics
Royco Instruments Inc
Ruge Associates
Trans-Sonics
Weksler Instruments
Weston Instruments
Yellow Spring Instr

THERMOMETERS, Thermistor (see also Thermistors —Cat. 8)

Aero Research Instr
Atkins Technical Inc
Brinkmann & Co C A
Electro-Medical Lab
Marshall Instrs
Precision Thermometer
Royco Instruments Inc
Simpson Electric
Tri-R Instruments
Victory Engrg Corp
Yellow Spring Instr

THERMOSTATS

Accuracy Scientific
Barber-Colman
Brabender Instr C W
Brinkmann & Co C A
Burling Instrument
Control Products
Controls Co of Amer
Deutsch Co
E-T-A Products
Edison Industries T A
Fenwal Inc
Fulton Sylphon Div
G-V Controls
General Controls
H-B Instrument
Johnson Service Co
Leslie Co
Mercoid Corp
Metals & Controls Div
Modern Lab Equipment
Norwood Controls
Nurnberg Scientific
Philadelphia Scien Glass
Pimex Inc
Powers Regulator
Stevens Mfg Co
Temperature Engrg Corp
Ulanet Co George
United Aircraft Prods
United Control Corp
United Electric Controls
Yellow Spring Instr

THERMOWELLS

Aero Research Instr
Bristol Co
Dillon & Co W C
Edison Industries T A
Foxboro Company
Gordon Co Claud S
Industrial Instr Corp
Karn Chemical Equipt
Leeds & Northrup
Martin & Co H S
McHugh & Son Raymond F
Moeller Instr
Pacific Transducer Corp
Richards Co Arklay S
Temperature Engrg Corp
Thermo Electric
Trinity Equipment
West Instrument
Weksler Instruments

TIME RECORDERS, including Running Time, Time Operation, Time Totalizers, etc.

Alina Corp
Bacharach Indus Instr
Bailey Meter Co
Bergen Labs Inc
Bristol Co
Brush Instruments Div
Capeway Instrument
Cincinnati Time Recorder
Cramer Controls
Curtiss Wright
Dickson Co
Ducommun Co M
Electric Tachometer
Electro Autosizing
Electro-Medical Lab
Engler Instr
Esterline-Angus
Federal Pacific
Fischer & Porter Co
Foxboro Company
General Controls
GE Apparatus Sales Div
Geotechnical Corp
Gilmore Industries
Haydon Co A W
Hobbs Corp John W
Impact-O-Graph Corp
Industrial Timer Corp
Lafayette Instr
Mast Development
Micronics Div
Parabam Inc
Sheffield Corp
Standard Instrument
Sticht Co Herman
Stromberg Time Corp
Thompson Clock Co
US Gauge Div
Weksler Instruments
Westinghouse Electric
Weston Instruments

TIME STUDY APPARATUS

Camera Equipt Co
Ducommun Co M
Engler Instr
Fischer & Porter Co
Lafayette Instr
Standard Instrument

TIMERS, including Automatic Reset, Cycle Interval (see also Program Controllers)

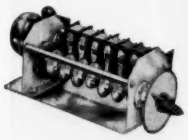
Abrams Instrument
Alina Corp
Allen-Bradley
Amglo Corp
Anadex Instruments Inc
Automatic Electric
Automatic Timing & Contls
Bald Eagle Corp
Beckman/Berkeley Div
Bergen Labs Inc
Berneo Engrg Corp
Black Sivalls & Bryson
Bristol Co
Bulova Research
Bulow Electric
Clark Controller
Controls Co of Amer
Cooper Development
Cramer Controls
Cutler-Hammer
Designers For Industry
DI/An Controls
Dietz Co Henry G
Dimco-Gray
Dynatronics Inc
Eagle Signal
Edwards Co Inc
Electric Eye Equip
Electro Instruments
Electro Precision
Engler Instr
Erie Pacific
Erie Resistor
Ewald Instruments
Falcon Alarm Co
Farmer Electric
Fischer & Porter Co
General Controls
GE Apparatus Sales Div
General Mills Inc
Gordon Enterprises
Hamilton Watch Co
Haydon Co A W
Haydon Div Gen Time
Hub-Pot Inc
Industrial Timer Corp
International Instrument
Karnish Instr Sales
Labline Inc
Machinery Electrification
Mallory & Co P R
Marsh Instr Co
Mast Development
Master Specialties
Micronics Div
Minarik Electric
Montgomery Mfg
Nati Time & Signal
Nuclear-Chicago
Nucleonic Corp of Amer
Paragon Electric
Partlow Corp
Philco Corp
Post Electronics

When Using This Guide look under the variable, e.g., Pressure Gages (not Gages, Pressure); or look under the noun—Magnets, Permanent (not Permanent Magnets).

Zenith AUTOMATIC CONTROL EQUIPMENT

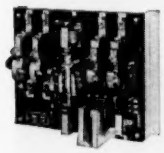
. . . accurate . . . dependable . . .
EASY TO ADJUST

ZENITH MULTI-CIRCUIT CYCLE TIMERS



Specially designed to accurately time any electrical operation. Set for on and off periods with as many circuits as desired. Operation: Cam-driven S.P.-D.T. micro-switch bank with synchronous motor. Also furnished without motor for elevator control, limit switch, etc.

ZENITH AUTOMATIC TRANSFER SWITCHES

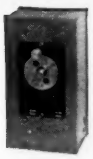


Automatic transfer to emergency source in 1/25th second . . . automatic return to normal voltage when restored. Supplied ac. or dc. Capacities up to 600 amps.

ZENITH INTERVAL TIMERS— MANUALLY PRE-SET

No clock springs to wind or break . . . powerful, self-starting, slow-speed, synchronous motor insures dependable operation. Timing ranges from 1 minute to 120 hours. 115 and 230 volt models. Explosion proof case shown meets National Electrical Code for Class 1, Group D., Hazardous Locations. Capacity: 1000 watts.

ZENITH RESET TIMERS— AUTOMATIC, REMOTE CONTROL



Easily pre-set, automatically reset. Synchronous motor opens and closes circuits as pre-set. May be used as timer in conjunction with standard start-stop push button station. Choice of mountings. Capacity: 1000 watts.

ZENITH PROCESS TIMER— with new PERCENTAGE CALIBRATION

For Hold Fire Control, Mixing Machinery, Testing Equipment, Fans, Heaters, etc. Wide variety of models for all types of adjustable automatic cycle timing. Total time cycle from 15 seconds to 24 hours, with range of adjustability to 94% for ON or OFF periods.

ZENITH AUTOMATIC CONTROL EQUIPMENT

Transfer Switches, Remote Control Switches, Automatic Time Switches, Automatic Reset Switches, Magnetic Contactors, Interval Timers, Process Timers, Program Clocks, Reversing Starters, Impulse Timers. Special Automatic Control Equipment For Special Jobs.

Request new catalog on Zenith Automatic Control Equipment. See classified telephone directory for local distributors.

ZENITH ELECTRIC CO.
159 W. WALTON ST., CHICAGO 10, ILLINOIS

CIRCLE 131 ON READER-SERVICE CARD

Precision Prods (Tulsa)
Racine & Co
Radiation Instr Dev Lab
Redford Corp
Rhodes Inc M H
Sanders Labs
Sangamo Electric Co
Scientific Industries
Sealy Instrument
Standard Electric Time
Streeter Amet
Stromberg Time Corp
Taylor Instrument
Telechrome Mfg Corp
Tempo Instrument
Thompson Clock Co
Trott Electronics
Unit Process Assemblies
U S Gauge Div
Wang Laboratories
Westinghouse Director Sys
Weston Instruments
Wilson & Co G C
Zenith Electric

TIMERS, Miseroseeond (sse also Counters, Electronic)

Applied Science Corp
Automatic Timing & Contls
Beckman/Berkeley Div
Computer Equipment
Corbett Science Labs
Curtiss Wright
Designers For Industry
Di/An Controls
Dynapar Corp
Engineered Electronics
Erie Pacific
Erie Resistor
Fischer & Porter Co
General Devices
Hamner Electronics
Haydon Co A W
Hewlett-Packard
Link Aviation
Machinery Electrification
Micronics Div
Northeastern Engrg
Philco Corp
Standard Electric Time
Stieht Co Herman
Systron Corp
Telechrome Mfg Corp
Trott Electronics
Sunshine Scientific

TORQUE CONTROL EQUIPMENT and GAGES

Alina Corp
B & F Instruments
Bergen Labs
Bulova Research
Bytrex Corp
Chatillon John
Emery & Co A H
Engis Equipment
Jo Line Tools
Metron Instrument
Performance Measurements
Sunshine Scientific
Universal Match
Vickers Electric Prods Div

TOTALIZERS, Demand

Disc Instruments
Fischer & Porter Co
GE Apparatus Sales Div
Sangamo Electric Co

TOTALIZERS, Electric Energy

Fischer & Porter Co
Sangamo Electric Co

TURBINE GOVERNORS

Bailey Co Chas M
Kahn & Co
Kieley & Mueller

ULTRA-VIOLET INDICATORS and/or RECORDERS

Analytic Systems
Bush Associates G F
DuMont Labs Allen B
Phoenix Precision Instr
Process & Instruments
Spectra Electronics
Western Radiation Lab
Weston Instruments
Westronics Inc

ULTRA-VIOLET LIGHT SOURCES

Alfa-American Corp
Amglo Corp
Boone Instrument
Bush Associates G F
Davenport Mfg
Epic Inc
Gaertner Scientific
Gates & Co Inc
Greiner Co Emil
Kemlite Labs
Mico Instr Co
Phoenix Precision Instr
Research Inc
Stocker & Yale
Switzer Brothers

VACUUM APPARATUS, including Pumps

Air-Shields Inc
Applied Dynamics
Applied Radiation Corp
Cash Valve Mfg
Central Scientific
Consol Electrodynamics
Electric Hotpack
Fisher Scientific
Gelman Instrument
Granville-Phillips
Green Rectifier
Greiner Co Emil
Hastings-Raydist
Ipsen Industries
Kahn & Co
Langmar Corp
Leitman Bros Inc
Martin & Co H S
Nash Engineering
National Appliance Co
NRC Equipment
Red Point Corp
Rochester Div CEC
Scientific Glass App
Smith Inc Arthur F
Temperature Engrg Corp
United Electric Controls
Vacuum Instrument
Vacuum Research
Varian Associates
Veeco Vacuum
Welch Scientific
Wheeler Mfg Co C H

VACUUM GAGES, McLeod

Central Scientific
Consol Electrodynamics
Ellison Draft Gage
GE Apparatus Sales Div
Greiner Co Emil
Hughes Products
Martin & Co H S
Moeller Instr Co
Nuclear Corp of Amer
Nurnberg Scientific
Rochester Div CEC
Scientific Glass App
Smith Inc Arthur F
Temperature Engrg Corp
Welch Scientific

VACUUM, HIGH (below 1 mu) CONTROLLERS, INDICATORS, and RECORDERS

Alfred Electronics
Applied Radiation Corp
Associated Valve Co
Barber-Colman
Central Electronic Mfgrs
Consol Electrodynamics
Ellison Draft Gage
Fischer & Porter Co
Fulton Sylphon Div
General Controls
Green Rectifier
Greiner Co Emil
Hastings-Raydist
Martin & Co H S
NRC Equipment
Nuclear Corp of Amer
Rochester Div CEC
Smith Inc Arthur F
Temperature Engrg Corp
United Electric Controls
Vacuum Instrument
Vacuum Research
Welch Scientific
Weston Instruments
Westronics Inc
Winslow Company Inc

TIMERS

FOR INDUSTRIAL PROCESS CONTROL

Standard, off-the-shelf timers for every control application, *plus* complete design and engineering for special requirements. Hundreds of models available, miniature to complete control panels. Rugged, dependable. Large knobs for easy setting, unique dial and pointer design for faster, more accurate readings. Easy one-hole mounting on most models. All time cycles from split seconds to days.

WRITE FOR NEW CATALOG

atc AUTOMATIC TIMING & CONTROLS, INC.
KING OF PRUSSIA, PENNA.
A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

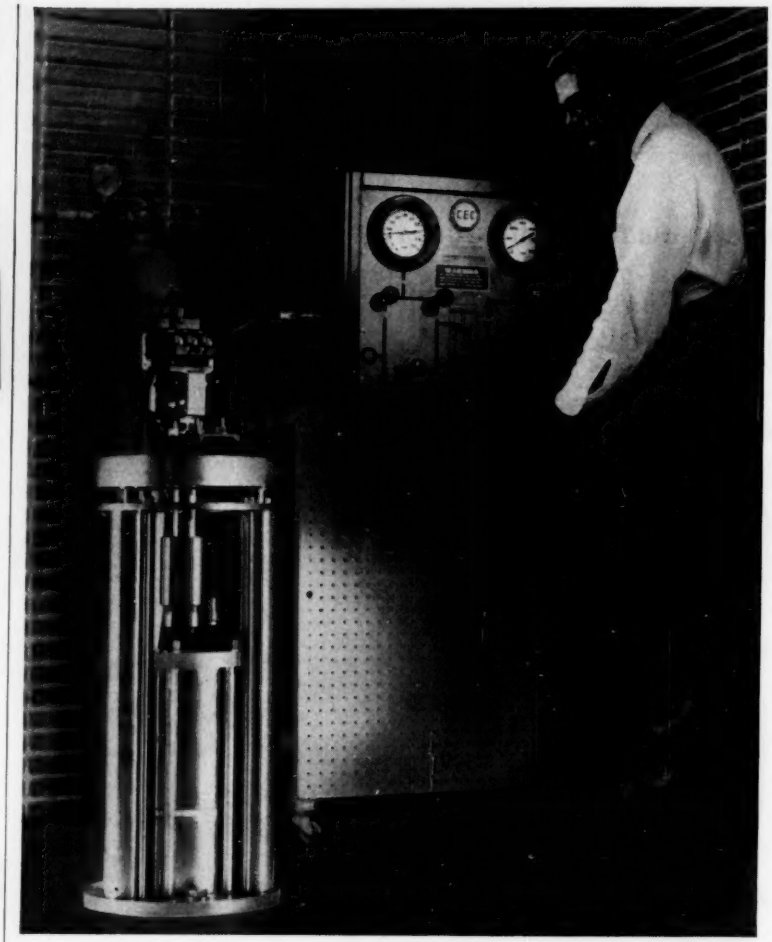
CIRCLE 132 ON READER-SERVICE CARD

3 important reasons why the LANGDON Vacuum Pump is replacing other makes!

1. No other laboratory vacuum pump can be cleaned in 30 minutes
2. No other laboratory vacuum pump permits oil change while running
3. No other laboratory vacuum pump uses ordinary SAE 30 motor oil

The LANGDON Vacuum Pump, for laboratory use, has attracted the interest, attention, and use by hundreds of organic research chemists because of its unique simplicity of design and ease of operation. Single stage, rotary, oil-sealed, water-cooled, high speed (1725 r.p.m.). No maintenance. No spare parts. Nothing to corrode or wear out. Positively noiseless. Uses only 50 cc of ordinary SAE 30 motor oil which is quickly changed while the pump is on stream. Every chemist can disassemble, clean and re-assemble in 30 minutes. The LANGDON operates at 35 l./m. (free air) to produce an ultimate vacuum of 50 microns. Permanently non-fouling. No springs to rust or corrode. "It looks as though you may have found the solution to the problem of distilling organic compounds", writes one user. "We use the LANGDON Pump to distill liquids which can decompose slightly in distillation, releasing halogen acids which shorten the life of a pump unless a good trap is included in the set up; we use no trap with the LANGDON", writes another user. It's no wonder, then, that the LANGDON is now successfully being used in the laboratories of hundreds of the largest chemical and petroleum companies, U. S. Government institutions and military installations and chemistry laboratories of colleges and universities in the U. S. and Canada. Under our guarantee, we will repair or replace without charge for one year any LANGDON Pump that fails to operate according to our specifications. Find out for yourself why this exceptional laboratory instrument is proving by its performance under a wide variety of operating conditions that it has unequalled superiority in the normal operating range of .5mm. and above. We shall be pleased to send you our illustrated, descriptive brochure, user list and operating instructions. Write today to: ***LANGMAR Corporation, 4875 West Armitage Avenue, Chicago 39, Ill.***

CIRCLE 133 ON READER-SERVICE CARD



New Hyge slashes cost of production-line *shock* tests

COSTS LESS, TESTS MORE
This new Hyge Shock Tester gives you two most widely specified shock pulses: 11 ± 1 ms ½ Sine, and 6 ± .5 ms Sawtooth . . . yet costs less than single-test units!

5 SHOTS IN 5 MINUTES, 5¢ APIECE
Low-cost bottled nitrogen powers the fast cycle . . . ready for the next shot in less than a minute!

EXCLUSIVE! FAST, EXTERNAL CHANGE OF WAVEFORM
Only this new Hyge changes waveform and thrust level without disassembly in a matter of minutes.

WIDEST TEST RANGE
From gram-weight components up to bulky 150-pound objects. Maximum acceleration 100G. Capacity: 15000 pounds specimen thrust.

COMPACT, CAN BE BUILT INTO PRODUCTION LINE
Height: 29¼". Base: 13" square.

Write for new Hyge Bulletin 4-71.

Consolidated Vacuum Corporation

ROCHESTER 3, NEW YORK

A SUBSIDIARY OF CONSOLIDATED ELECTRODYNAMICS CORPORATION
(FORMERLY ROCHESTER DIVISION)

CIRCLE 134 ON READER-SERVICE CARD

VACUUM CONTROL TO .05 PSI

The Conoflow VH-20 Vacuum Regulator can solve your problem of controlling vacuum i n low capacity systems. Ideal for laboratory work, and for test stands, especially where accurate simulation of high altitude conditions is required. Holds absolute pressure to as low as 1 inch ±.05 inches mercury. Provides quick, easy adjustment on dead end or low flow service.

Available from stock in ¼ inch size, of forged brass and stainless steel construction. PRICE $25.00. Discounts for quantities. Instruction bulletin included with order.

Cono-Controls FOREMOST IN FINAL CONTROL ELEMENTS

WRITE FOR BULLETIN H-2 ON PNEUMATIC REGULATORS

CC-606

CONOFLOW CORPORATION

SUBSIDIARY OF WALWORTH COMPANY

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CIRCLE 135 ON READER-SERVICE CARD

VACUUM CONTROLLERS, INDICATORS and/or RECORDERS

Bailey Co Chas M
Bailey Meter Co
Barber-Colman
Bristol Co
Cash Valve Mfg
Conoflow
Consol Electrodynamics
Crosby-Ashton
Dickson Co
Esterline-Angus
Fischer & Porter Co
Fulton Sylphon Div
GPE Controls
General Controls
GE Apparatus Sales Div
Hastings-Raydist
Hays Corporation
Helcoid Gage Div
International Register
Kieley & Mueller
Manning Maxwell & Moore
Mason Neilan
M-H Brown Instrs Div
Moore Products Co
Murphy Mfg Inc
NRC Equipment
Norwood Controls
Nuclear Corp of Amer
Precision Thermometer
Rochester Div CEC
Scientific Instrument
Smith Inc Arthur F
Specialties Inc
Taylor Instrument
Temperature Engrg Corp
Veeco Vacuum
Wallace & Tiernan
Wekster Instruments
Welch Scientific
Weston Instruments
Westronics Inc

VACUUM-OPERATED DEVICES, Electric Motor

Cash Valve Mfg
General Controls
GE Apparatus Sales Div
Hammel-Dahl Div
United Electric Controls

VALVE OPERATING DEVICES, Hydraulic including Cylinder

Acme Industrial Co
Annin Company
Arkwin Industries Inc
Automatic Switch Co
Cash Valve Mfg
Defender Instrument
Denison Engrg Div
DeZurik Corp
Eastern Industries
Electric Eye Equip
Ferguson Hille
General Controls
General Regulator
Grove Valve & Regulator
Hydromatics Inc
Jamesbury Corp
Kieley & Mueller
Ledeen Inc
Manning Maxwell & Moore
Midwestern Instrs
M-H Valve Div
Model Engrg
North American Mfg
Oilgear Co
PKL Valve & Mfg
Pneu-Hydro Valve
Research Controls
Rockwell Mfg Co
Stratos Div
Taylor Instrument
United Aircraft Prods
Vickers-A & E Center
Vinson Mfg Co
Weston Hydraulics Ltd

VALVE OPERATING DEVICES, Pneumatic, including Cylinder

American Meter Co
Annin Company
Arkwin Industries Inc
Associated Valve Co
Automatic Switch Co
Automatic Valve Co
Bailey Meter Co
Black Sivalls & Bryson
Bristol Co
Cash Co A W
Cash Valve Mfg
Conoflow
Dahl Co Geo W
DeZurik Corp
Edward Valves Inc
Ferguson Hille
Fisher Governor
Foxboro Company
Fulton Sylphon Div
GPE Controls
General Controls
General Regulator
Grove Valve & Regulator
Hammel-Dahl Div
Hankison Corp
Haveg Industries
Hydromatics Inc
Jamesbury Corp
Johnson Service Co
Kieley & Mueller
Leslie Co
Mason Neilan
M-H Valve Div
Model Engrg
Moore Products Co
North American Mfg
Pneu-Hydro Valve
Powers Regulator
RKL Valve & Mfg
Research Controls
Rockwell Mfg Co
Seely Instrument
Stratos Div
Taylor Instrument
United Aircraft Prods
Vinson Mfg Co
Weston Hydraulics Ltd

VALVE OPERATING DEVICES, Solenoid

Acme Industrial Co
Altair Inc
Amer Meas & Control
Arkwin Industries Inc
Automatic Switch Co
Automatic Valve Co
B-I-F Industries
Carruthers & Fernandez
Conoflow
Detroit Controls
Ferguson Hille
Foxboro Company
General Controls
General Regulator
Grove Valve & Regulator
Hammel-Dahl Div
Haveg Industries
Johnson Corp
Koontz-Wagner Elec
Norwood Controls
Pneu-Hydro Valve
Skinner Elec Valve
United Aircraft Prods
Vacuum Research
Vickers-A & E Center
Vinson Mfg Co
Weston Hydraulics Ltd.

VALVE POSITIONERS

Annin Company
B-I-F Industries
Bailey Meter Co
Barber-Colman
Bristol Co
Cash Co A W
Conoflow
Detroit Controls
Electric Regulator
Ferguson Hille
Fisher Governor
Foxboro Company
Fulton Sylphon Div
GPE Controls
General Controls
General Regulator
Hagan Chem & Controls
Hammel-Dahl Div
Haveg Industries
Johnson Service Co
Kieley & Mueller
Leeds & Northrup
Manning Maxwell & Moore
Mason Neilan
Model Engrg
Moore Products Co
Pneu-Hydro Valve
Powers Regulator
Redford Corp
Reliance Instr Mfg
Rockwell Mfg Co
Tejax Engrg Corp
Taylor Instrument

YEARS AHEAD IN DESIGN . . .

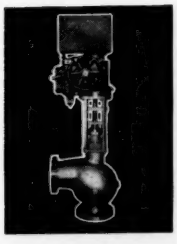
CONTROL VALVES BY CONOFLOW

← SERIES LB CONTROL VALVES

- Integrated body-actuator design outmodes conventional valves.
- Cono J Positioner sets new standard for precise proportional positioning.
- Extra-thick body walls give added protection against corrosion and erosion.

↑ SERIES HB SAUNDERS VALVES

In all sizes for on-off and throttling control.



← SERIES S CONTROL VALVES

Specifically designed for the tough services.

SERIES AB → CONTROL VALVES

For economical handling of small flows.

SPECIFY Conoflow Control Valves to get the best valves available for your control application. Write today for Control Valve Bulletins I-A.

CC606

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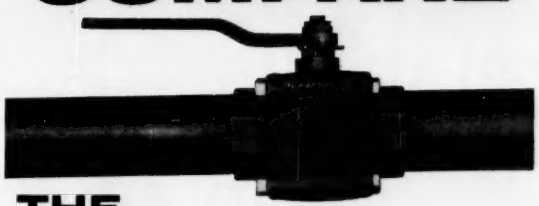
2100 ARCH STREET • PHILADELPHIA 3, PA.

CIRCLE 136 ON READER-SERVICE CARD

COMPARE



THE ECON-O-MISER BALL VALVE . . . with LUBRICATED PLUG VALVES

The **ECON-O-MISER** ball valve provides smooth, round, **two-way flow! Easy to service without removal from the line . . .** half million cycles not unusual . . . acts as both valve and union.

For revealing facts request bulletin EB 101.

WORCESTER

VALVE CO., INC. | WORCESTER 10, MASS.

CIRCLE 137 ON READER-SERVICE CARD

United Aircraft Prods
U S Gauge Div
Vinson Mfg Co

VALVES, Ball

Hydromatics Inc
Jamesbury Corp
Worchester Valve

VALVES, Butterfly

Aeronaut & Instr Div
B-I-F- Industries
Baldwin-Lima-Hamilton
Black Sivalls & Bryson
Conoflow Corp
Consol Controls Corp
Continental Equipment
Dahl Co G W
Eclipse Fuel Engrg Co
Fisher Governor Co
Foxboro Co
Hammel-Dahl Div
Haveg Industries
Johnson Service Co
Kelley & Mueller
Mason-Neilan Div
M-H Valve Div
Rockwell Co W S
Schutte & Koerting
Stratos Div

VALVES, CONTROL

Acme Industrial Co
Allenair Corp
Allis-Chalmers
Amer Meas & Control
Annin Company
Arkwin Industries Inc
Associated Valve Co
Atlas Valve Co
Automatic Valve Co
B-I-F Industries
Bailey Co Chas M
Barber-Colman
Barksdale Valves
Black Sivalls & Bryson
Bristol Co
Cash Co A W
Cash Valve Mfg.
Conoflow
Continental Equipment
Controls Co of Amer
Dahl Co Geo W
Daniel Orifice Fitting
Denison Engrg Div
Deutsch Co
DeZurik Co
Eastern Industries
Eclipse Fuel Engrg
Edward Valves Inc
Electric Regulator
Ferguson Hille
Energy Kontrols
Fischer & Potter Co

Fisher Governor
Foxboro Company
Fulton Sylphon Div
Golden Anderson
General Controls
Granville-Phillips
Grove Valve & Regulator
Hammel-Dahl Div
Haveg Industries
Hays Mfg Co
Hoke Inc
Humphrey Products Div
Imperial Brass Mfg
Industrial Engrg Corp
Infilco Inc
Instr Development Co
Johnson Service Co
Keckley Co O C
Kieley & Mueller
Klipfel Valves
Koontz-Wagner Elec
Ledeen Inc
Leonard Inc Wallace O
Leslie Co
Linear Controls
Mason-Neilan
Marotta Valve
McIlvaine O T
M-H Valve Div
Model Engrg
North American Mfg
OPW-Jordan
Oilgear Co

PK Industries
Partlow Corp
Petrometer Corp
Pneu-Hydro Valve
Powers Regulator
RKL Valve & Mfg
Research Controls
Reliance Instr Mfg
Robbins Aviation Inc
Seely Instrument
Simmonds Aerocessories
Taylor Instrument
Uniflow Valve
United Aircraft Prods
Universal Match
Vacuum Research
Valcor Engrg Corp
Vanton Pump & Equip
Versa Products
Vickers—A & E Center
Vinson Mfg Co
Weston Hydraulics Ltd

VALVES, Diaphragm Seal, including Saunders Patent, Crane, Wynn Type, etc.

Annin Company
Associated Valve Co
Automatic Switch Co
Black Sivalls & Bryson
Bristol Co
Cash Valve Mfg

Conoflow
Dahl Co Geo W
Grinnell Co
Grove Valve & Regulator
Haveg Industries
Hills-McCanna
Hoke Inc
Humphrey Products Div
Hydromatics Inc
Imperial Brass Mfg
Kieley & Mueller
Leslie Co
Mason Neilan
M-H Valve Div
Model Engrg
Nuclear Materials & Eqpt
Pneu-Hydro Valve
Powers Regulator
Research Controls
Taylor Instrument
Uniflow Valve
United Aircraft Prods

VALVES, Flexible Sleeve

Farris Engrg Corp
Fisher Governor
Grove Valve & Regulator
Haveg Industries
International Instrument
Pneu-Hydro Valve
RKL Valve & Mfg
Red Jacket Co
United Aircraft Prods
Vinson Mfg Co

VALVES, Float-operated

Associated Valve Co
Atlas Valve Co
Bailey Co Chas M
Black Sivalls & Bryson
Clark Mfg
Defender Instrument
Fisher Governor
Fulton Sylphon Div
General Controls
Golden Anderson
Grove Valve & Regulator
Haveg Industries
Instruments Inc
Keckley Co O C
Kieley & Mueller
Klipfel Valves
Martin & Co H S
Mason Neilan
McDonnell & Miller
Model Engrg
Phillips & Co H A
Pneu-Hydro Valve
Simmonds Aerocessories
United Aircraft Prods
Vinson Mfg Co

VALVES, Gage Cocks

Defender Instrument
Detroit Controls
Edward Valves Inc
Grove Valve & Regulator
Haveg Industries
Keckley Co O C
Kunkle Valve Co
Marsh Instr Co

VALVES, High Pressure

Acme Industrial Co
Allis-Chalmers
Altair Inc
Annin Company
Arkwin Industries Inc
Associated Valve Co
Atlas Valve Co
Autoclave Engineers
Automatic Switch Co
Bailey Co Chas M
Barber-Colman
Barksdale Valves
Black Sivalls & Bryson
Carruthers & Fernandez
Cash Valve Mfg
Conoflow
Dahl Co Geo W
Daniel Orifice Fitting
Davies Brothers
Dennison Engrg Div
Detroit Controls
Deutsch Co
Dragon Engrg Co
Edward Valves Inc
Fisher Governor
Fulton Sylphon Div
General Controls
Golden Anderson
Grove Valve & Regulator
Hammel-Dahl Div
Haveg Industries
Hoke Inc
Hydromatics Inc
Imperial Brass Mfg
Kahn & Co
Kieley & Mueller
Klipfel Valves
Koontz-Wagner Elec
Leonard Inc Wallace O
Leslie Co
Marotta Valve
Marsh Instr Co
Mercoid Corp
M-H Valve Div
Model Engrg
Oilgear Co
Pneu-Hydro Valve
Republic Mfg Co
Research Controls
Robbins Aviation Inc
Rockwell Mfg Co
Ruska Instrument Corp
Seely Instrument
Simmonds Aerocessories
Stratos Div
Taylor Instrument
Uniflow Valve
Universal Match
United Aircraft Prods
Valcor Engrg Corp
Velan Valve Corp
Vickers-A & E Center
Victor Equipment

Vinson Mfg Co
Weston Hydraulics Ltd
Yarnall Waring

VALVES, Plug

Allis-Chalmers
Arkwin Industries Inc
Bailey Meter Co
Circle Seal Products
Conant Bros Co
Conoflow
DeZurik Corp
Dragon Engrg Co
Edward Valves Inc
General Controls
Haveg Industries
Hoke Inc
Hydromatics Inc
Imperial Brass Mfg
Marotta Valve
Pneu-Hydro Valve
Republic Mfg Co
Rockwell Mfg Co
Simmonds Aerocessories
Taylor Instrument
United Aircraft Prods
Vacuum Research
Vanton Pump & Eqpt Corp
Vickers-A & E Center
Vinson Mfg Co
Worcester Valve

VALVES, Needle

Allis-Chalmers
American Meter Co
Annin Company
Arkwin Industries Inc
Associated Valve Co
Autoclave Engineers
Automatic Switch Co
Bailey Meter Co
Dahl Co Geo W
Daniel Orifice Fitting
Dragon Engrg Co
Edward Valves Inc
Fulton Sylphon Div
General Controls
Greiner Co Emil
Grove Valve & Regulator
Hammel-Dahl Div
Haveg Industries
Hoke Inc
Imperial Brass Mfg
Industrial Instr Corp
Kieley & Mueller
Manning Maxwell & Moore
Marsh Instr Co
Model Engrg
Pneu-Hydro Valve
Republic Mfg Co
Research Controls
Robbins Aviation Inc
Simmonds Aerocessories
Taylor Instrument
Uehling Instrument
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United Aircraft Prods
Versa Products
Vickers-A & E Center
Victor Equipment
Vinson Mfg Co

VALVES, Packless

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Annin Company
Arkwin Industries Inc
Associated Valve Co
Automatic Switch Co
Conant Bros Co
Conoflow
Dahl Co Geo W
Defender Instrument
Fulton Sylphon Div
General Controls
Grove Valve & Regulator
Hammel-Dahl Div
Haveg Industries
Henry Valve Co
Hills-McCanna
Hoke Inc
Imperial Brass Mfg
Kahn & Co
Kieley & Mueller
Leslie Co
Marsh Instr Co
Mason Neilan
Mercoid Corp
Pneu-Hydro Valve
Powers Regulator
Research Controls
RKL Valve & Mfg
Simplex Valve & Meter
Taylor Instrument
Uniflow Valve
United Aircraft Prods
Valcor Engrg Corp
Vinson Mfg Co
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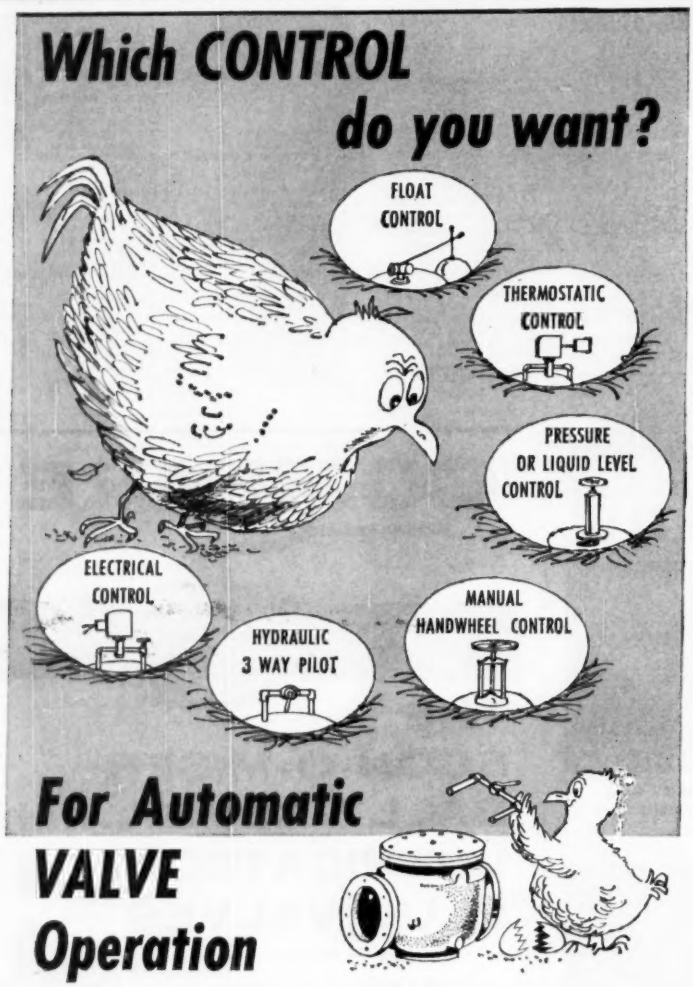
VALVES, Relief and Safety

Associated Valve Co
Arkwin Industries Inc
Automatic Switch Co
Bailey Co Chas M
Carruthers & Fernandez
Cash Co A W
Cash Valve Mfg
Circle Seal Products
Conax Corp
Conoflow
Crosby-Ashton
Dahl Co Geo W
Daniel Orifice Fitting
Denison Engrg Div
Eclipse Fuel Engrg
Edward Valves Inc
Farris Engrg Corp
Fisher Governor
Fulton Sylphon Div
General Controls
Golden Anderson
Grove Valve & Regulator
Hammel-Dahl Div
Haveg Industries



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VALVES FOR...
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WIDE RANGE OF SPECS...
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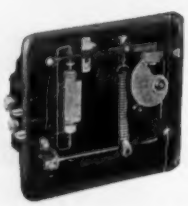

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POSITIONING RELAY

• Accurately positions a control valve or drive to the control requirements as received pneumatically from the control station. Also included is a cam adjustment for tuning valve or drive characteristics to system characteristics. This unit is ideally suited for control of flow characteristics of regulating devices.

Standard SAMA signal ranges of 3-15 psig or 3-27 psig.

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WATCHES, Chronometer, including Marine (see also Clocks)

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Thayer Scale Corp
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Weighing & Control Comps
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Baldwin-Lima-Hamilton
Barber-Colman
Bytrex Corp
Daytronic Corp
Detecto Scales
Exact Weight Scale
Gilmore Industries
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Photo ¾ actual size

"DEMI G" SERIES

Packless "DEMI G" Valves are miniature in size, weight and price. They employ a patented form and give bubble-tight shut-off. They are available in many bar-stock materials with a wide variety of tee-handle and toggle actuators and have innumerable applications in the chemical, oil, instrumentation, aircraft and atomic energy fields . . . to name but a few.

Basic "DEMI G" Valves employ metal-to-metal seating, however TEFLON seats for vacuum service, neoprene diaphragms for toggle actuation and all TEFLON interior models . . . as well as those with bolted bonnets are standardly available. Where space and exacting control are considerations, the "DEMI G" Series of packless valves will do the job better.

PRESSURE RATING	
Metal Body & Diaphragm	750 psi at 450°F
Neoprene Diaphragm	100 psi at 180°F
TEFLON Body & Diaphragm	100 psi at 450°F
MAXIMUM Cv	0.4
CONNECTIONS	1/16" to ½" N.P.T.

Send for the "DEMI" Catalog D-1 and other technical data on Dahl pneumatic and hydraulic valves.

GEORGE W. DAHL COMPANY, INC.
86 TUPELO STREET, BRISTOL, RHODE ISLAND

CIRCLE 142 ON READER-SERVICE CARD

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controls

for pressure, liquid level, temperature and flow

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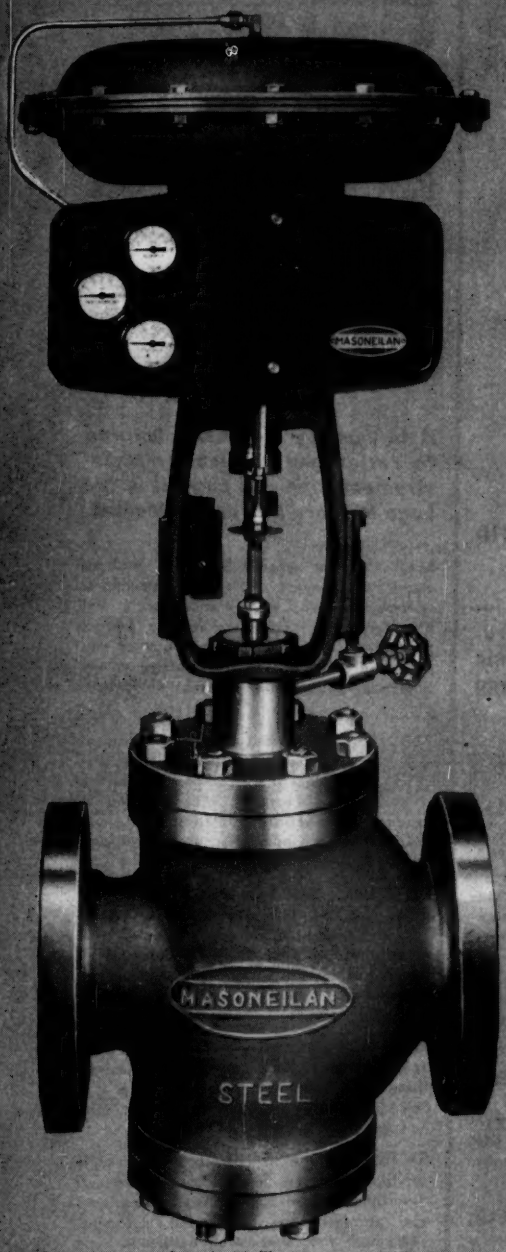
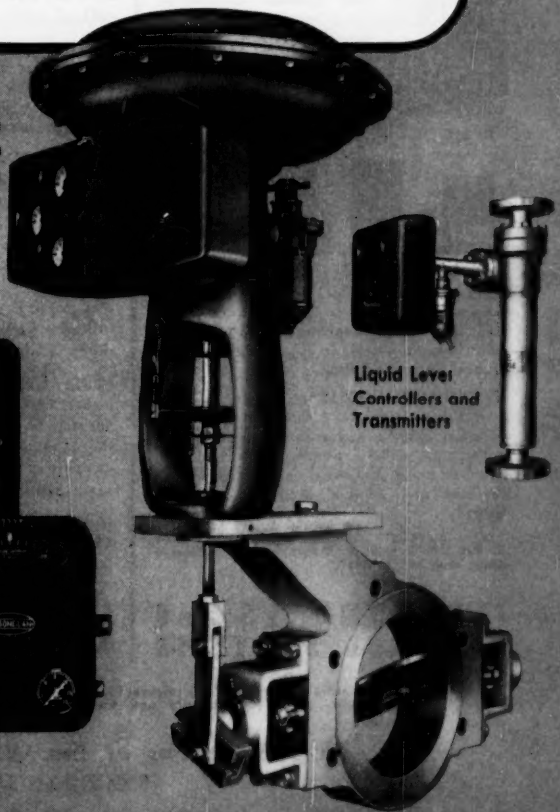
MND-86

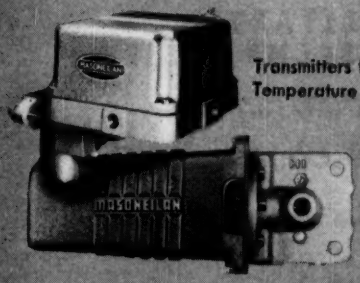


Control Valves shown with Electropneumatic Positioner

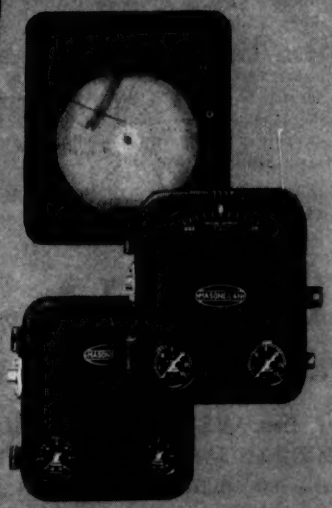
Butterfly Valves shown with Spring-diaphragm Actuator and Pneumatic Positioner



Liquid Level Controllers and Transmitters



Transmitters for Pressure, Temperature or Flow



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AND STILL GROWING!

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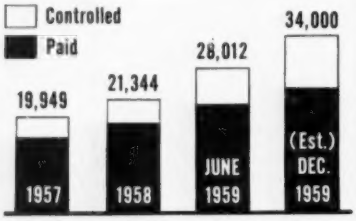

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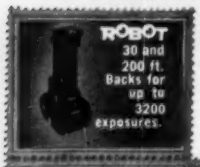

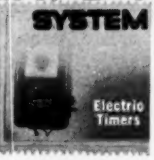

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Geotechnical Corp
Gordon Enterprises
Heitz Inc Karl
Henson Co Fred C
Instrument Corp of Fla
Jarrell Ash Co
Palos Optical Co
Richardson Camera Co
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Traid Corp
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Camera Equipt Co
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Fecker Inc
Gordon Enterprises
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IBM Corp
Leeds & Northrup
Librascope Inc
Link Aviation
MacLaren & Co F B
Maxson Corp W L
M-H Aeronautical Div
Missouri Res Labs
Oltronix Inc
Panellit Inc
Philbrick Researches Inc
Precision Mechanisms Corp
Ramo-Wooldridge
Rattray & Co Geo
Reeves Instr Corp
Reflectone Corp
Research Inc
Southwestern Indus Elx
Standard Electric Time
Sterling Precision
Swartwout Co
Systron Corp
Tapco Group
Tech Measurement Corp
Telechrome Mfg Corp
Weston Instruments

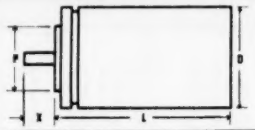
COMPUTERS, Digital, Electronic, (see also Digital Building Blocks)
Allegany Instrument
American Electronics Inc
Applied Research Labs
Arma Division
Autonetics
Bendix Computer Div
Bowmar Instrument
Bulova Research
Burroughs Corp
CGS Laboratories Inc
Clary Corp
Computer Control
Control Data Corp
Curtiss Wright
Delco Radio
DI/An Controls
Digitronics Corp
DJECO
Ebex
Electrodata Div
Electro-Autosizing
Electronic Computer Co
Ferranti Electric
GE Computer Dept
GPE Controls
General Mills Inc
Genesys Corp
Giannini Controls Corp
Gulton Industries
Hagan Chem & Controls
Hoover Electronics
Hughes Products
IBM Corp
Kearfott Co
Leeds & Northrup
Librascope Inc
Link Aviation
Maxson Corp W L
M-H Aeronautical Div
Monroe Electronics Div
Navigation Computer Corp
Packard Bell
Panellit Inc
Philco Corp
Ramo-Wooldridge
Ransom Research
Royal McBee Corp
Southwestern Indus Elx
Specialties Inc
Systron Corp
Tapco Group
Tech Measurement Corp
Technitrol Engrg
Telechrome Mfg Corp
Thompson-Ramo-Wooldridge
Wang Laboratories
Weston Instruments

COMPUTERS, Mechanical and Electro-Mechanical, including Desk Computing Machines
Allen Business Machines
American Electronics Inc
Bulova Research
Burroughs Corp
Clary Corp
Detecto Scales
Epsco
Friden Inc
GPE Controls
Genesys Corp
Gerber Scientific Inst
Giannini Controls Corp
IBM Corp
Kearfott Co

Induction Motors of California Offers Step-Servo Motor Line

A full line of step-servo motors, sizes 5, 8, 11, 15 and 23, designed for digital-to-analog conversion in 45° increments up to 160 pulses per second, are available with impedance of 15 to 320 ohms and voltage range of 20 to 50 VDC and meet environmental requirements of MIL-E-5272B and MIL-E-5400. No mechanical detents are employed.

GENERAL SPECIFICATIONS



I. M. C. P/N	Dim. in Inches D	L	P	X	Rotor Inertia GM-CM²	Min. Holding Torq. Oz.-In.	Max. Watts Per
005-801	.500	1.20	.375	11/32	0.20	0.4	8
9708-024	.750	1.09	.500	11/32	0.65	0.8	10
011-859	1.062	1.36	.625	3/8	0.65	1.4	15
9711-007	1.062	1.76	.625	3/8	2.5	1.4	15
9711-056	1.062	1.78	.625	3/8	2.5	1.2	15
9711-053	1.062	1.36	.625	3/8	2.5	1.0	15
9715-001	1.437	1.75	.875	3/8	2.5	1.8	25
023-801	2.250	1.75	2.00	5/8	5.0	3.0	50

INDUCTION MOTORS OF CALIF. DIV.
IMC MAGNETICS CORP., N.Y.
6060 Walker Avenue, Maywood, California
LUdlow 3-4785

CIRCLE 146 ON READER-SERVICE CARD

Librascope Inc
Link Aviation
MacLaren & Co F B
Monroe Electronics Div
North Electric Co
Rattray & Co Geo
Sterling Precision

CONVERTERS, Analog-to-Digital
Adage Inc
Airpax Electronics
American Data Div
American Electronics Inc
American Meter Co
Anadex Instruments Inc
Analogue Controls Inc
Andromeda Inc
Bailey Meter Co
Bendix Cincinnati Div
Burroughs Corp
Chesapeake Instr
Coleman Electronics
Coleman Engrg
Computer Control
Computer Equipment
Computer Measurements
Consol Controls
Consol Electrodynamics
Consolidated Systems
Cox Instruments
Curtiss-Wright IMI
Datex Corp
Detecto Scales
Detroit Controls
DI/An Controls
Digitran Co
Dynamics Research
Dynatronics Inc
Ebex
Electro-Autosizing
Electro Instruments
Electro-Mec Lab
Electronic Associates
Electronic Computer Co
Epsco Inc
Fischer & Porter Co
General Mills Inc
Genesys Corp
Gerber Scientific Inst
Gilmore Industries
Gulton Industries
Gurley W & L E
Hagan Chem & Controls
Hewlett-Packard
Hoover Electronics
Instr Development Labs
Julie Research Labs
Kearfott Co
Librascope Inc
Link Aviation
Milgo Electronic
M-H Aeronautical Div
Model Engrg
Non-Linear Systems
Northeastern Engrg
Norwood Controls
Orbitran Co
Packard Bell
Panellit Inc
Philco Corp
Radiation Instr Dev Lab
Ramo-Wooldridge
Ransom Research
Rattray & Co Geo
Rotary Devices Corp
Southwestern Indus Elx
Sterling Precision
Streeter Amet
Swartwout Co
Systron Corp
Taylor Instrument
Tech Measurement Corp
Telechrome Mfg Corp
Telecomputing Corp
United Engineers Inc
Wang Laboratories
Weston Instruments
Wright Machinery Co

CONVERTERS, Binary-to-Decimal
Adage Inc
Anadex Instruments Inc
Bailey Meter Co
Beckman/Berkeley Div
Burroughs Corp
Coleman Electronics
Computer Control
Computer Equipment
Com uter Measurements
Datex Corp
DI/An Controls
Digitran Co
Dymec Inc
Dynatronics Inc
Ebex
Electro Instruments
Electronic Associates
Electronic Computer Co
Engineered Electronics
Epsco Inc
Fischer & Porter Co
Genesys Corp
Gerber Scientific Inst
Gurley W & L E
Haydon Co A W
Hoover Electronics
Julie Research Labs
Kearfott Co
Librascope Inc
Link Aviation
Model Engrg
Navigation Computer Corp
Northeastern Engrg
Norwood Controls
Orbitran Co
Packard Bell
Panellit Inc
Ransom Research
Rotary Devices Corp
Tech Measurement Corp
Wang Laboratories

CONVERTERS, Digital-to-Analog
Adage Inc
Analog Controls Inc
Andromeda Inc

INCREMAG®

COUNTER—DIVIDER WITH MEMORY

These devices are compact—solid state—magnetic counter dividers. Capable of counting rates to 100,000 PPS. Division up to 16 per stage. Applications include counting, dividing, storage, timing, control and programming. Available as components or systems. Write your requirements to us.

GENERAL TIME CENTRAL RESEARCH LABORATORY
107 LAFAYETTE STREET, NEW YORK 13, N. Y.
WORTH 6-0822

CIRCLE 145 ON READER-SERVICE CARD

Bailey Meter Co
Beckman/Berkeley Div
Burroughs Corp
Coleman Electronics
Coleman Engrg
Computer Control
Computer Equipment
Curtiss-Wright IMI
Datex Corp
DI/An Controls
Dynatronics Inc
Ebex
Electro Instruments
Electronic Associates
Eosco Inc
Genesys Corp
Gerber Scientific Inst
Gulton Industries
Hagan Chem & Controls
Hewlett-Packard
Hoover Electronics
Julie Research Labs
Kearfott Co
Librascope Inc
Link Aviation
Milgo Electronic
M-H Aeronautical Div
Model Engrg
Navigation Computer Corp
Northeastern Engrg
Packard Bell
Panellit Inc
Philco Corp
Ramo-Wooldridge
Ransom Research
Rotary Devices Corp
Spectrum Instruments
Telechrome Mfg Corp
United Engineers Inc
Wang Laboratories
Wauch Engrg Co
Westinghouse Director Sys

CONVERTERS, Punched Cards

American Data Div
American Electronics Inc
Anadex Instruments Inc
Beckman/Berkeley Div
Burroughs Corp
DI/An Controls
Digitronics Corp
Electro Instrumnts
Fischer & Porter Co
Genesys Corp
Gerber Scientific Inst
Gordon Enterprises
Gulton Industries
IBM Corp
Librascope Inc
M-H Davies Labs Div
Moseley Co F L
Philco Corp
Systematics Inc
Wang Laboratories

CONVERTERS, Punched Tape

American Electronics Inc
Anadex Instruments Inc
Burroughs Corp
CGS Laboratories Inc
DI/An Controls
Digitronics Corp
Electro Instruments
Ferranti Electric
Fischer & Porter Co
Genesys Corp
Gerber Scientific Inst
Gulton Industries
IBM Corp
Librascope Inc
Moseley Co F L
Northeastern Engrg
Philco Corp
Systematics Inc
Wang Laboratories

COUNTERS, Electrical Impulse

Abrams Instrument
American Data Div
Automatic Timing & Contls
Baird-Atomic Inc
Beckman/Berkeley Div
Burroughs Corp
C & K Components
DI/An Controls
Digitran Co
Durant Mfg
Eagle Signal
Electro Precision
Electronic Computer Co
Epic Inc
Erie Pacific
Erie Resistor
Exline Engrg
Fischer & Porter Co
Freed Transformer
General Controls
GE Heavy Mil Elx Dept
Genesys Corp
Gurley W & L E
Haydon Co A W
Hewlett-Packard
Instrument Corp of Fla
IBM Corp
Landis & Gyr
Link Aviation
Monroe Components Div
Navigation Computer Corp
North Electric Co
Northeastern Engrg
Nuclear EL & Corp
Philco Corp
Photocon Research
Presin Co
Ram Meter Inc
Ransom Research
Redford Corp
Richardson Scale Co
Sciaky Bros Inc
Standard Instrument
Stelma Inc
Stewart M C
Systron Corp
Telecomputing Corp
Trott Electronics
Veeder-Root Inc
Wang Laboratories
Walkirt Co

COUNTERS, Photoelectric

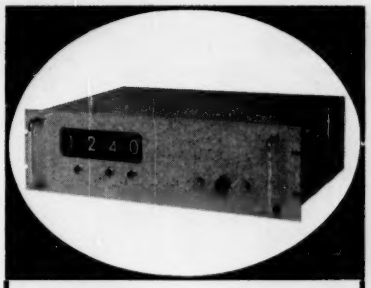
Allied Radio
Appalachian Electronic
Beckman/Berkeley Div
Beva Laboratory
Davenport Mfg
Durant Mfg
Dynapar Corp
Epic Inc
Freed Transformer
General Controls
Gurley W & L E
Hewlett-Packard
Hoffman Electronics
Instr Development Co
Kavamil Co
Machinery Electrification
Navigation Computer Corp
Photobell Co
Post Electronics
Potter Instr Co
Redford Corp
Spectra Electronics
Standard Instrument
Tri-Tronics Co
Trott Electronics
Veeder-Root Inc
Worner Electronic Devices

COUNTERS, Photoelectric, Curve Followers

Geotechnical Corp
Sterling Precision

DATA-PROCESSING SYSTEMS and COMPONENTS, including Tape Transports, Readers, Loggers, etc. (see also Computers, also Printers)

Airtronics Inc
American Data Div
American Electronics Inc
Anadex Instruments Inc
Arnoux Corp
Aironic Products
B & F Instruments
Bendix Computer Div
Burroughs Corp
Bytrex Corp
CGS Laboratories Inc
Calif Technical Indus
Chrono-Log Corp
Clary Corp
Coleman Engrg
Computer Equipment
Coleman Electronics
Consol Electrodynamics
Consolidated Systems
Control Data Corp
Cox Instruments
Curtiss-Wright IMI
Designers for Industry
DI/An Controls
Digitronics Corp
Dymec Inc
Dynatronics Inc
Ebex
Electric Eye Equip
Electro Instruments
Electrodata Div
Electronic Associates
Electronic Computer Co
Fairchild Camera & Instr
Ferranti Electric
Fischer & Porter Co
Flow Corporation
Friden Inc
General Devices
General Precision Lab
Genesys Corp
Geotechnical Corp
Gerber Scientific Inst
Gilmore Industries
Gordon Enterprises
Gyrex Corp
Hagan Chem & Contrls
Hanson-Gorrill-Brian
Hermes Electronics
Hoover Electronics
Hughes Products
IBM Corp
Kavamil Co
Kearfott Co
Leeds & Northrup
Librascope Inc
Link Aviation
Magnasyne Mfg Co
Magnavox Co
Marquardt-Pomona Div
Midwestern Instrs
Milgo Electronic
M-H Davies Labs Div
M-H Missile Equipt Div
Missouri Res Labs
Monroe Components Div
Moore Associates
Non-Linear Systems
North Electric Co
Panellit Inc
Parabam Inc
Philco Corp
Potter Instr Co
Radiaphone Co
Ramo-Wooldridge
Ransom Research
Richardson Camera Co
Sciaky Bros Inc
Southwestern Indus Elx
Specialties Inc
Stromberg-Carlson San Diego
Stromberg Time Corp
Systematics Inc
Systron Corp
Tally Register Corp
Tapco Group
Taylor Instrument
Technitrol Engrg
Telechrome Mfg Corp
Telecomputing Corp
Thompson-Ramo-Wooldridge
Traid Corp



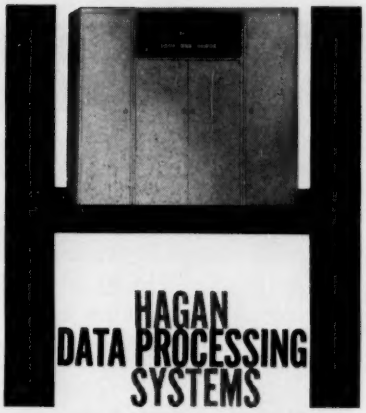
PARABAM DIGITAL CLOCK

EVERY MINUTE, EVERY TENTH-MINUTE OR EVERY SECOND THROUGHOUT THE DAY, PARABAM DIGITAL CLOCKS FURNISH NON-AMBIGUOUS CONTACT CLOSURES. THIS CONTACT OUTPUT MAY BE USED TO PROVIDE A TIME OF DAY READING FOR PROCESS CONTROL SYSTEMS, TEST DATA RECORDING SYSTEMS, COMPUTER SYSTEMS OR OTHER DATA LOGGING AND PROCESSING SYSTEMS. THE CLOCK IS ALSO DESIGNED FOR USE AS A MASTER TIME SOURCE FOR DIGITAL COUNT-DOWN SYSTEMS OR ELAPSED TIME INDICATORS.

STANDARD PARABAM DIGITAL CLOCKS FEATURE SINGLE PLANE IN-LINE LAMP-BANK DISPLAYS, REMOTE INDICATOR ASSEMBLIES, AND PUSH-BUTTON RESET SWITCHES.

PARABAM, INC.
13000 YUKON AVE., HAWTHORNE, CALIF.

CIRCLE 147 ON READER-SERVICE CARD

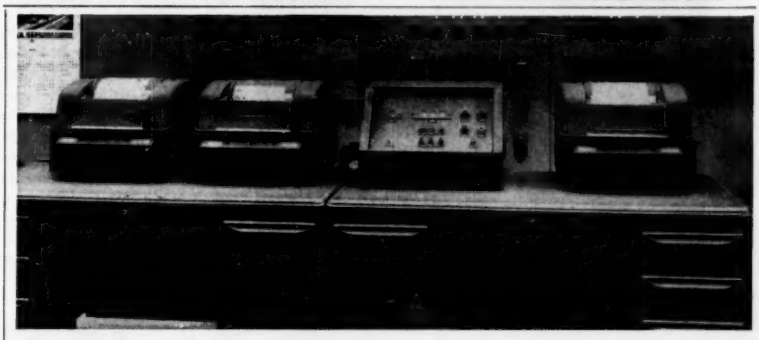


HAGAN DATA PROCESSING SYSTEMS

The Hagan Kybernetes Series 2000 data processing system, utilizing solid state components, has these features:
• *Flexibility*—basic logging unit easily expanded for more complex operations, including off-normal scanning, trend logging, computing or integrating, etc.
• *Modular Construction*—simplifies maintenance and extension of system.
• *Optimum Reliability*—solid state components and simplified, logical design add to life and provide a high degree of dependability.

HAGAN CHEMICALS & CONTROLS, INC.
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Fiumendosa No. 13, Milano, Italy

CIRCLE 148 ON READER-SERVICE CARD



Bailey METROTYPE Information Systems

Accurate, dependable Bailey Measuring Instruments and Transducers combine with the latest techniques in data handling to produce an integrated system best suited to your process.

A Bailey METROTYPE Information System rapidly scans hundreds of measurements of temperatures, pressures, flows, etc., sounds an alarm for off-normal values, and reads out any or all data periodically or on demand.

Transmission of both analog signals to, and digital signals from the METROTYPE Information System may be via: high frequency signals (radio, UHF, microwave); direct cable (AC or DC); or long distance lines (telephone, telegraph, carrier currents).

Readout methods from which you may choose include any one or any combination of the following: Printed Log Sheets, Indicator Lights, Punched Tape, Magnetic Tape.

The system utilizes the Bailey Building Block method of construction with functionally designed interchangeable plug-in modules. All inter-unit wiring connections are accessible at rear of cabinet. Where applicable, each module incorporates visual indications of circuit action. A centrally located check point panel is included for all important input, output, and control signals.

Your METROTYPE Information System may be installed in connection with a new, complete measuring and controlling system, or it may be used with existing primary measuring devices.

Request Bulletins E72-1 and E72-2.

BAILEY METER COMPANY
1041 Ivanhoe Road • Cleveland, O.
Bailey Meter Company Limited, Montreal, Canada

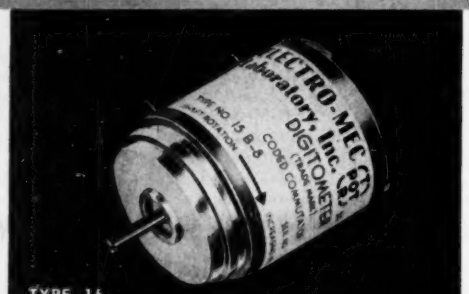
CIRCLE 149 ON READER-SERVICE CARD

ELECTRO-MEC'S *New* DIGITOMETER™

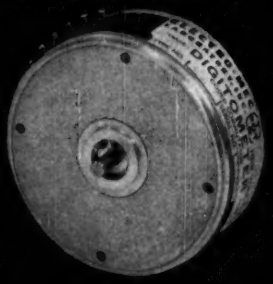
(A Shaft Angle Digitalizer)

SHAFT POSITION TO NUMBERS
for record-indication or for computation.
NOW — A rugged shaft digitalizer
(non-ambiguous)
for AIRBORNE ENVIRONMENTS

NO GEARS • NO BACKLASH



TYPE 15
Diameter: 1.5"
Accuracy: 1 part in 256 parts for 360° of shaft rotation



TYPE 30
Diameter: 3.0"
Accuracy: 1 part in 1024 parts for 360° of shaft rotation

NO NON-AMBIGUITY NETWORKS

The system designer doing digital servo work recognizes the benefits of ELECTRO-MEC DIGITOMETERS because

1. Shaft position to electrical contact closures
2. No ambiguity (Gray Code)
3. Low shaft torque requirements
4. High slewing speed (650 rpm)
5. Small size
6. Lightweight
7. Designed to withstand the rigors of MIL (E) 5272 environmental test specification.

ELECTRO-MEC Laboratory, Inc.
47-51 33 Street, Long Island City 1, N. Y.

For data sheets or further information write to our Engineering Dept.

CIRCLE 150 ON READER-SERVICE CARD

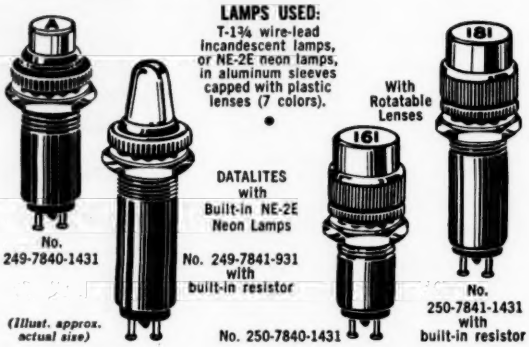
In this brochure—complete facts on DIALCO's

DATALITES®

For the Computer-Automation Industries

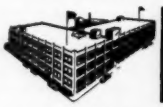
DATALITES by DIALCO are ultra-miniature Indicator Lights specially designed to meet the critical requirements of the computer-automation fields. Made in 2 basic styles: *Lamp Holders with* DIALCO'S own *replaceable Lamp Cartridges* (see above); or integrated DATALITES *with Built-in Neon Lamps* which are *not replaceable* (see below). Ultra-compact, single units mount in ⅜" clearance hole; the twin-lamp assembly mounts in ¾" clearance hole.

LAMPS USED:
T-1¾ wire-lead incandescent lamps, or NE-2E neon lamps, in aluminum sleeves capped with plastic lenses (7 colors).



DATALITES have fully insulated terminals and conform to all applicable military specifications. Integrated units are available *with or without built-in resistors.* The cylindrical lenses can be hot-stamped with digits, letters, etc. Complete details in *Brochure L-160.* Send for it now.

SAMPLES ON REQUEST—AT ONCE—NO CHARGE



Foremost Manufacturer of Pilot Lights

DIALIGHT CORPORATION

42 STEWART AVE., BROOKLYN 37, N. Y. • HYacinth 7-7600

CIRCLE 151 ON READER-SERVICE CARD

Union Switch & Signal
Vanguard Instrument
Wang Laboratories
Weston Instruments
Westronics Inc

DIGITAL BUILDING BLOCKS, including Computer Components

Airtronics Inc
Anadex Instruments Inc
American Electronics Inc
Beckman/Berkeley Div
Burroughs Corp
Burroughs Elx Tube
Bytrex Corp
Chrono-Log Corp
C & K Components
Clary Corp
Coleman Electronics
Computer Control
Computer Equipment
Consol Electrodynamics
Consolidated Systems
Cooper Development
Curtiss-Wright IMI
Dalmotor Div
Datex Corp
Di/An Controls
Digitronics Corp
DJECO
Dymec Inc
Dynatronics Inc
Electro Precision
Electrodata Div
Engineered Electronics
Engis Equipment
Epsco Inc
GPE Controls
GE Heavy Mil Elx Dept
General Mills Inc
Genesys Corp
Gulton Industries
Hagan Chem & Contrls
Harvey-Wells
Hoover Electronics
Kavamil Co
Kearfott Co
Leeds & Northrup
Librascope Inc
Link Aviation
MacLaren & Co F B
Marquardt-Pomona Div
Milgo Electronic
Monroe Electronics Div
Navigation Computer Corp
North Electric Co
Packard Bell
Parabam Inc
Ransom Research
Rixon Electronics
Systron Corp
Traid Corp
Walkirt Co
Wang Laboratories

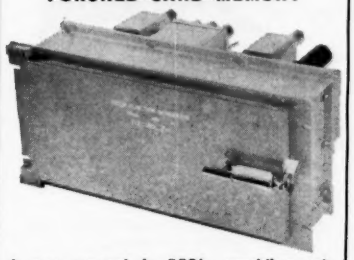
DIGITAL READOUT INDICATORS (see also Data Processing)

Airpax Electronics
American Electronics Inc
Anadex Instruments Inc
BJ Electronics
Beckman/Berkeley Div
Borg Equipment Div
Bowmar Instrument
Burroughs Corp
Burroughs Elx Tube
Bytrex Corp
Consol Electrodynamics
Consolidated Systems
Cox Instruments
Detroit Contro.s
Dialight Corp
Digitran Co
Durant Mfg
Dymec Inc
Dynamics Research
Dynapar Corp
Electro Instruments
Electrodata Div
Electronic Associates
Electrosnap
Engineered Electronics
Engis Equipment
Erie Pacific
Fischer & Porter Co
General Controls
General Railway Signal
Genesys Corp
Gerber Scientific Inst
Gilmore Industries
Gulton Industries
Hagan Chem & Controls
Haydon Co A W
Hughes Products
Kay Electric
Laboratory for Electronics
Landis & Gyr
Librascope Inc
Link Aviation
Marquardt-Pomona Div
Mast Development
Milgo Electronic
Milman Engrg Co
Navigation Computer Corp
Non-Linear Systems
North Atlantic Indus
Northeastern Engrg
Radio Frequency Labs
Slocomb Co J T
Sterling Precision
Stromberg-Carlson San Diego
Systron Corp
Tech Measurement Corp
Telechrome Mfg Corp
Union Switch & Signal
United Engineers Inc
Westronics Inc

MEMORIES, Electrostatic, including C-R Tubes (see also Computers)

Burroughs Corp
Datex Corp
Electronic Tube
Hughes Products
IBM Corp

DIODE FUNCTION GENERATOR
featuring a
PUNCHED CARD MEMORY

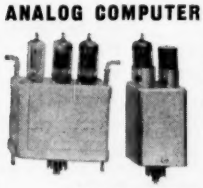


A new concept in DFG's providing outstanding performance & convenience

0.10 % Card Programming Accuracy
0.02 % Long Term Repeatibility
20 Segments & Zero Offset
10 KC Band Width
10 v/v Slope Change/Breakpoint

Increases computation capacity & lowers operating costs through function programming in seconds, eliminating idle computer time & providing a permanent library of functions.

ANALOG COMPUTER AMPLIFIERS



40,000,000 gain
0.1mv stability
± 100v output
Convenient plug-in case. Rugged & shielded

LOW COST

ELECTROL, Inc.
ELECTRONIC CONTROLS & COMPUTERS
9000 W. Pico Blvd. Los Angeles 35, Calif.

CIRCLE 152 ON READER-SERVICE CARD

New UNION readout instruments withstand shock, vibration and extreme temperature changes

Union Switch & Signal's new READALL* readout instrument replaces complicated systems of lights and relays for reading, storing or transferring all types of information for industrial and military applications. It is not to be confused with conventional indicating devices.

Designed to meet requirements of MIL-E-5422D. The new READALL readout instrument is precision-built and provides instantaneous and continuous operation under conditions of shock, vibration and extreme ranges in temperature. The digital display includes characters in numerical sequence from 0 to 9 plus two blank spaces. 7/32-inch characters can be illuminated red or white as desired; when not illuminated, they appear white against a black background.

Reliability. Performance through one million random operations is an inherent feature of the new READALL instrument. Each module is gasket-sealed in its case to exclude moisture and seal out foreign particles. An especially thin enclosed DC motor, containing ball bearings, permits more efficient operation.

Modular Construction. A unique feature of the readout instrument is its modular construction. It can be used individually or in groups to display multiple characters in a single case.

Direct Code Translation. The operation of the READALL readout instrument is based on a positioning system using a four-bit code. The visual display is the result of a direct electro-mechanical conversion of a binary signal to a decimal read-out. There is no need for additional conversion equipment. Separate code and motor circuits permit the use of the readout instrument in low-level circuitry.

Electrical and Visual Data Storage. Once positioned, the information is displayed until a new code is transmitted to the instrument. No power is consumed while the information is retained. This data may be stored or read-out electrically for further transmission or recording.

Operate Time. The operate time varies from 0.1 second to 1.0 second depending on character position.

Weight and Size. Maximum weight including case is seven ounces; without case, four and one-half ounces. Size encased is 5 13/64 inches long, 1 47/64 inches high and 39/64 inch wide. The new READALL instrument is designed for operation over a temperature range of -54°C to +71°C in humidities up to 100% and altitudes up to 70,000 feet. For more information, write for Bulletin 1019.

*Trademark

"Pioneers in Push-Button Science"

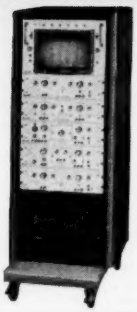
UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA

CIRCLE 153 ON READER-SERVICE CARD

brush ULTRALINEAR RECORDING SYSTEMS

Whatever you want to measure, only Brush gives you freedom of choice: ink, electric or thermal writing—curvilinear or rectilinear trace presentation—configuration. Available in 2, 4, 6 or 8 channels.

2 channel carrier multi-purpose, accepts either resistive or inductive inputs.



6 channel high gain records signals as low as 10 microvolts.

8 channel medium gain wide input range, 10 millivolts to 400v.

Select your OSCILLOGRAPHS

Frequency response . . . D.C. to 100 cps with Brush amplifiers.

Writing methods . . . . Ink, electric curvilinear, or thermal rectilinear.

Chart speeds . . . . . Instantaneous electric selection of up to 16 speeds, remote or on-the-spot control.

Chart take-up . . . . . External or internal, easy loading.

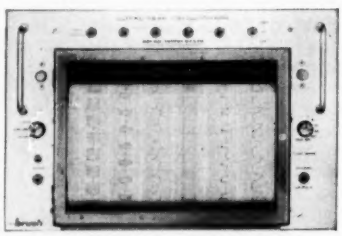
Mounting . . . . . Rack-mounted, cart-mounted, portable and bench-top models.

Reliability . . . . . Readily adaptable to MIL specifications.

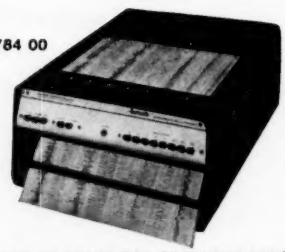
ENCLOSURES	CHANNELS	WRITING METHOD & WRITING PLANE	MODEL NO.
PORTABLES	2	ink, horizontal	RD 2321 00
	2	ink-electric, horizontal	RD 2322 00
	4	ink, horizontal	RD 2341 00
	4	ink-electric, horizontal	RD 2342 00
	6	ink, horizontal	RD 2361 00
	6	ink-electric, horizontal	RD 2362 00
RACK, CONSOLE CABINET OR CART MOUNTED	2	ink-electric, vertical	RD 2622 00
	2	ink-electric, horizontal	RD 2722 00
	4	ink, vertical	RD 2641 00
	4	ink-electric, vertical	RD 2642 00
	4	thermal, vertical	RD 2644 00
	6	ink, vertical	RD 2661 00
	6	ink-electric, vertical	RD 2662 00
	6	thermal, vertical	RD 2664 00
	6	thermal, horizontal	RD 2664 50
	8	ink-electric, vertical	RD 2682 00
	8	thermal, horizontal	RD 2684 50
CART AND BENCH TOP	6	thermal, horizontal	RD 2764 00
	8	thermal, horizontal	RD 2784 00

RD 2322 00

RD 2662 00



RD 2784 00

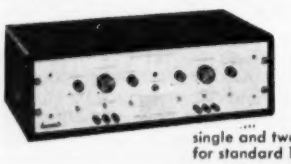


PORTABLE OSCILLOGRAPHS in 2, 4 and 6 channels

RACK MOUNTING OSCILLOGRAPHS in 2, 4, 6 and 8 channels

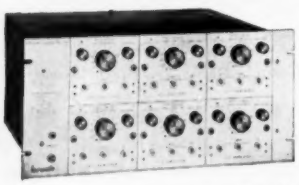
CART OR BENCH TOP OSCILLOGRAPHS in 6 or 8 channels

Select your AMPLIFIERS



single and two channel configuration for standard 19″ rack mounting.

six and eight channel configuration for standard 19″ rack.



		SINGLE CHANNEL	
UNIVERSAL Model RD 5612 00		multi-purpose carrier type for wide range of measurements. Input box RA 5212 00 for resistive transducers, RA 5222 00 for LVDT's.	
HIGH GAIN D.C. Model RD 5615 10		amplifies signals as low as 10 microvolts.	
Model RD 5615 00		chopper stabilized, amplifies signals as low as 100 microvolts.	
SERVO ANALYZER Model RD 5616 00		monitors any servo system in carrier frequency range of 50 to 10,000 cps.	
MEDIUM GAIN		TWO CHANNEL	
Model No.	Sensitivity	Drift	Power Line Frequency
RD 5621 00	10 mv/line (mm)	less than ½ line (mm) per hr., 1 line 8 hrs.	60 cps, ± ½ cps
RD 5621 01	10 mv/line (mm)	less than ½ line (mm) per hr., 1 line 8 hrs.	50-2000 cps
RD 5621 02	50 mv/line (mm)	less than 1/10 line (mm) per hr., ¼ line 8 hrs.	50-2000 cps
MEDIUM GAIN		SIX AND EIGHT CHANNEL	
Basic Pen Drive Amplifier System Model RA 5680 00 includes chassis and separate electronic regulated power supply with capacity to operate up to 8 plug-in pen drive amplifiers.			
Plug-in Model RD 5211 03		sensitivity 10 mv/line (mm), less than ½ line (mm) per hr. drift, 1 line 8 hrs., power req. 50-2000 cps.	
Plug-in Model RD 5211 04		sensitivity 50 mv/line (mm), less than 1/10 line (mm) per hr. drift, ¼ line 8 hrs., power req. 50-2000 cps.	

CIRCLE 160 ON READER-SERVICE CARD

brush ULTRALINEAR RECORDING SYSTEMS

MARK II RECORDER

Completely self-contained recorder, plugs in anywhere for easy recording of electrical and physical phenomena, d.c. to 100 cps . . . in research . . . design and development . . . production . . . servicing . . . field test and installation.

RD 2521 00

Sensitivity . . . . . 10 mv/line (mm). Full scale deflection from chart center ± 200 mv.
Measurement range . . .010v. to 400v.
Input impedance . . . . 5 megohm single-ended, 10 megohm balanced.
Event channels . . . . 2, 12v. internal power source actuated by external signal.
Chart speeds . . . . . 1, 5, 25, 125 mm/sec.
Power requirements . . 105-125v., 60 cps, 135 watts at 115v.
Net weight . . . . . 32 pounds.

Convenient operation: fast paper loading without threading, pushbutton controls for 4 chart speeds.

Complete recorder with built-in, permanently calibrated amplifiers.

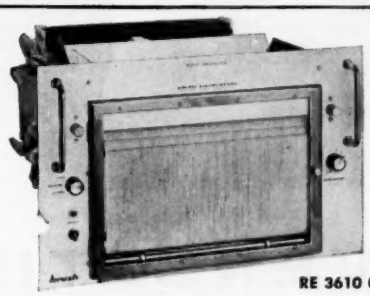
Trouble-free writing system features self-cleaning, self-priming, rugged pens, extra-large ink reservoir.

OPERATIONS MONITOR

Simplifies complex checkouts . . . monitors 100 channels of data simultaneously.

Simultaneously records 100 channels of sequential or operational information. On-off input data presented provides a record of events, their duration, and their time relationship to each other. Electric writing styli record in less than one millisecond after receiving a signal—handle up to 500 signal changes per second. Remote or on-site chart speed control.

Available in two models, the RE 3610 00 or: Military Model RE 3610 02 which fully complies with MIL-E-4158A.

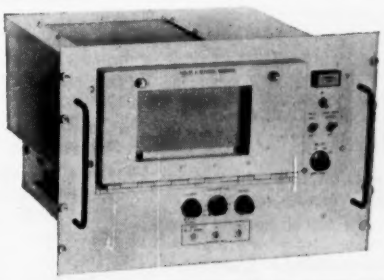


RE 3610 00

Writing method . . . Electric—instantaneous, dry and permanent.
Capacity . . . . . 100 easy-to-identify channels. Records on preprinted chart paper, 12″ wide, 500′ long.
Chart speeds . . . . Instantaneous electric selection of 8 chart speeds, on-site or remote control.
Chart take-up . . . . Provision for both internal chart take-up of entire roll, or external feed.
Mounting . . . . . Mounts in standard 19″ rack.

MILITARIZED
RECORDING SYSTEMS

Fully militarized versions of all equipment are available. Illustrated is the combination Analog and Operations Recorder providing simultaneous analog recording (D. C. to 100 cps) and ten "go and no go" sequential channels. Recording system is complete with oscillograph, amplifier and power supply. Equipment designed to comply with Mil. E-1640 Mil. E-4158, E-4970 and other pertinent specifications as required by user.



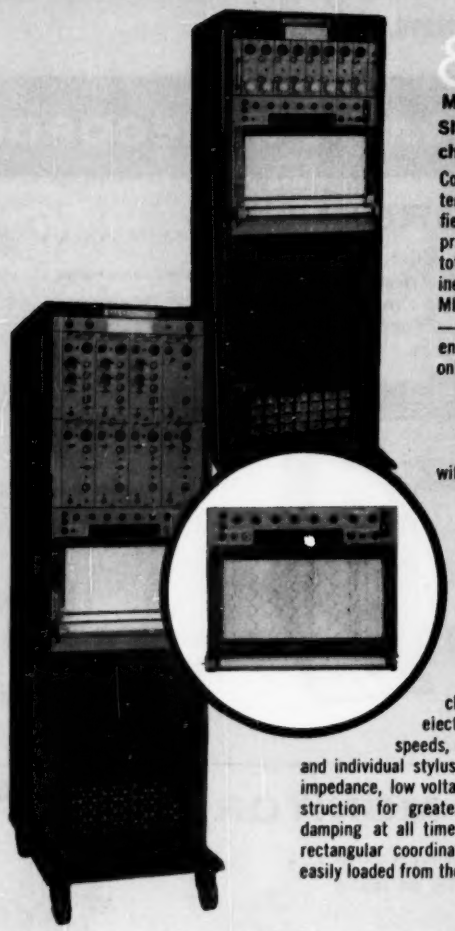
WRITE FOR LITERATURE OR, FOR APPLICATION ASSISTANCE, CONTACT YOUR BRUSH FACTORY BRANCH OR REPRESENTATIVE.

Factory branches, service and warehousing at Arlington, Va., Boston, Cleveland, Los Angeles, San Francisco and Seattle; engineering representatives in all key locations.

brush INSTRUMENTS
DIVISION OF
37th & PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

CIRCLE 160 ON READER-SERVICE CARD

VERSATILE, RELIABLE
RECORDING INSTRUMENTATION FROM
SANBORN



350

MAXIMUM PERFORMANCE VERSATILITY — 6 or 8 channels, DC to 150 cps

Linearity 0.5%, 3 db down at 150 cps (10 div peak-to-peak amplitude). Improved current feedback power amplifiers, negligible drift. Total panel space only 38½". Efficient ducted air system assures constant, adequate cooling of all circuits for reliable operation.

VERSATILE "350" SERIES PREAMPS — compact (10½" high) interchangeable units with highly developed circuitry; for use in "350" systems, or individually (see "450" unit Amplifiers) with its own power supply to drive optical recorders, tape recorders, 'scopes, meters, etc. Available types include

- Carrier
- DC Coupling
- Phase Sensitive Demodulator
- True Differential Wide Band DC (4 models)
- Basic Chopper

with others in development

850

MINIMUM PANEL SPACE, SIMPLER PREAMPS — 6 or 8 channels, DC to 150 cps

Comparable performance to "350" System; uses same Recorder-Power Amplifier unit. Modules of up to 8 plug-in preamps occupy 7" of panel space; total panel space only 28" (max.); cabinet 60" high.

MINIATURIZED "850" SERIES PREAMPS — simplified, economical plug-in front ends for "850" systems; panel area only 2 1/16" x 7". Types include

- Carrier (separate MOPA required)
- Phase Sensitive Demodulator
- DC Coupling
- Basic Chopper (MOPA required)

with others in development

BASIC "350"/"850" 6- and 8-CHANNEL RECORDER-AMPLIFIER UNITS

6- or 8-channel recorder with transistorized, current feedback Power Amplifiers and voltage regulated power supply. Sensitivity 0.1 volt/chart div; panel space 17½"; nine electrically controlled pushbutton chart speeds, or remote control; automatic over-all and individual stylus heat control; time-code marker; low impedance, low voltage galvanometers with enclosed construction for greater reliability; true velocity feedback damping at all times, limiting ahead of output. Inkless, rectangular coordinate recording on Permapaper charts, easily loaded from the front.

150

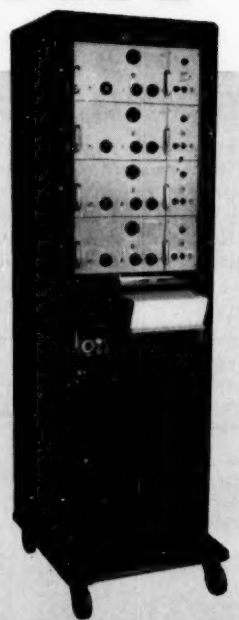
VERSATILE, ECONOMICAL — 1 to 8 channels DC to 100 cps

Twelve front ends cover the widest variety of applications. Frequency response 2 db down at 100 cps; over-all linearity better than 1%; basic sensitivity from 10 μv/div to 0.1 volt/div, depending on preamplifier. Current feedback driver amplifier and regulated power supply for each channel; amplifiers, recorder available in individual portable cases.

1- to 8-CHANNEL "150" SERIES RECORDERS Nine chart speeds (multi-channel types), shifted mechanically; automatic over-all and individual stylus heat control; recorder assembly slides out for easy paper loading, better view of recording and marking notations on record; time-code marker; paper take-up; inkless, rectangular coordinate recording on Permapaper charts.

FAMILIAR "150" SYSTEM FRONT ENDS — feature wide choice of types, plug-in design; all have attenuator ratios of 1, 2, 5, 10 . . . to 1000, many have calibrated zero suppression.

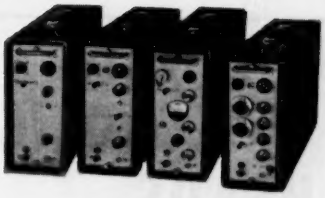
- AC-DC
- Carrier
- Servo Monitor (phase-sensitive demodulator)
- DC Coupling
- Log-Audio
- Low Level
- Stabilized DC
- AC Wattmeter
- RMS Volt/Ammeter
- 400 Cycle Frequency Deviation
- Frequency Meter
- Triplexer 3-channel electronic switch



when preamplification is not needed —

SIMPLIFIED 6- or 8-CHANNEL SYSTEM — 5 volts full-scale

Model 358-5480 system for computer readout, telemetry recording, DC voltage monitoring and similar applications requiring no preamplification. Control panel provides position, smooth gain and attenuation controls, and internal calibration signal. Sensitivity 0.1 volt/div; linearity 0.5% of full scale, gain stability better than 1%; current feedback amplifiers, velocity feedback damping; 9 electrically controlled chart speeds and all other "350" Recorder features.



SELF-CONTAINED "450" UNIT AMPLIFIERS with power supply

Versatile "350" Series preamplifiers with individual power supplies in portable cases; for driving 'scopes, optical oscillographs, tape recorders, etc. Available in "450" cases or four-unit modules in 19" frame for rack mounting. One "450" case and power supply can serve any "350" preamp.

"150" SYSTEM AND PROGRAMMER FOR COMPUTER READOUT

6- or 8-channel consoles in 46½" high mobile cabinet. Dual-Channel DC Amplifiers have sensitivities from 0.01 to 10 volts/div; internal calibration 2 volts ±1%; frequency response flat to 20 cps down 3 db at 50 cycles. Optional Programmer sequences system operation in 20 steps including recorder turn-on, calibration, computer DC level reading, recording for pre-set time, turn-off and reset.

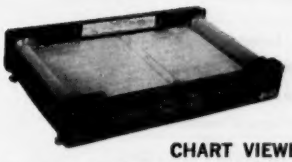
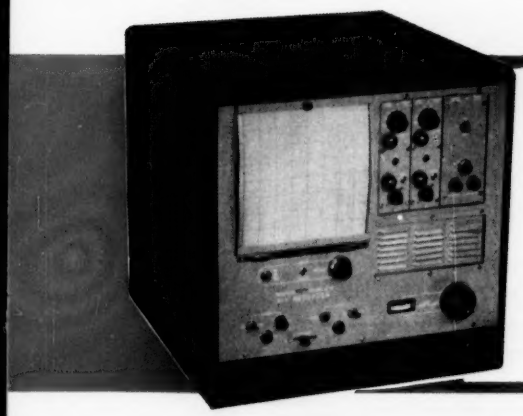


CHART VIEWER for easier editing and study

Permits convenient viewing and interpretation of Sanborn and other strip charts up to 200 ft. long and 16" wide, at continuously variable speeds from ¾" to 7½" per second. Single control for direction and paper speed. Viewing table 18½" x 24".



HIGH SPEED OPTICAL X-Y RECORDER — flat response to 100 cps, writing speeds to 2500"/sec.

Can record such rapidly changing variables as acceleration and vibration of mechanical elements, transistor characteristics, etc. Mirror-galvanometers and a light beam produce recording traces on ultraviolet-sensitive 8" x 8" direct-print paper that develops immediately by exposure to normal room light. Interchangeable "850" system preamplifiers are used for each axis; new preamps and time base generator now in development allow a wide variety of applications.

LINEAR MOTION TRANSDUCERS

. . . to measure displacement

PROBE STYLE — complete, ready to connect to 150, 350 or 850 Series Carrier Amplifiers; uses differential transformer. High sensitivity, unlimited resolution, linearity 0.5%; stroke range ±0.050", sensitivity 50 chart div deflection/0.001" displacement. Model 580 for flange mounting has plug-in cable, Model 581 for screw mounting has integral cable.

LINEARSYN — differential transformer; error due to non-linearity less than 1% of full scale; unlimited resolution. High shock, vibration resistance; hermetically sealed, immersible. Strokes from ±0.005" to ±10.000"; high sensitivities. Six Standard series (three shielded, three unshielded), five models in each series.

. . . to measure velocity

LVsyn — accurate, stable calibration; unlimited resolution. Single-ended or push-pull output. Strokes to 9"; output sensitivities from 35 to 650 mv/inch/sec. Twelve standard Models, with regular or unbreakable cores.

CIRCLE 157 ON READER-SERVICE CARD

Other Sanborn precision instruments include . . .

Individual Recording Galvanometers, Power Amplifiers, Recording Assemblies . . . Servo Monitor Phase Shifters . . . Event Recorders, 4 to 32 channels . . . Monitor Meter . . . Wide Band Driver Amplifier . . . Master Slave Control . . . Pressure Transducers.

For complete descriptive information and specifications, write to the Industrial Division in Waltham or contact your local Sanborn Sales-Engineering representative.

SANBORN COMPANY

INDUSTRIAL DIVISION
175 Wyman Street, Waltham 54, Mass.

MAGNETIC RECORDING HEADS

- DIRECT
- FM
- Pulse Width
- Flux Sensitive (Magnetometer Type) Playback Heads

Custom designed recording heads built to customer specifications.

Complete Integral Head Banks — designed for versatility, accuracy and ease of maintenance.

NO QUANTITY TOO SMALL

HOUSTON
MAGNETIC PRODUCTS, INC.
A subsidiary of houston instrument
1520 Foley St. • HO 8-2696

CIRCLE 154 ON READER-SERVICE CARD

Intercontinental Elx
Sterling Precision

MEMORIES, Magnetic, including Tape, Drum, Cores (see also Computers)
Adage Inc
Airtronics Inc
Anadex Instruments Inc
Analogue Controls Inc
Andersen Labs
BJ Electronics
Bryant Computer
Burroughs Corp
Computer Control
Computer Equipment
Consol Electrodynamics
Consolidated Systems
Di/An Controls
Electrodata Div
Erie Resistor
Fairchild Camera & Instr.
Ferranti Electric
GE Heavy Mil Elx Dept
General Mills Inc
General Railway Signal
General Time Central
Geneava Corp
Hughes Products
IBM Corp
Kearfott Co
Laboratory for Electronics
Leach Corporation
Librascope Inc
Midwestern Instrs
M-H Davies Labs Div
Minnesota Mining & Mfg
Monroe Electronics Div
North Electric Co
Packard Bell
Philco Corp
Reeves Soundcraft
Rese Engrg Inc
Rixon Electronics
Wang Laboratories

PRINTERS, Numerical Data, including Data Loggers, High Speed Printers, Typewriters, etc. (see also Data Processing)
American Data Div
American Electronics Inc
BJ Electronics
Beckman/Berkeley Div
Burroughs Corp
Chrono-Log Corp
Clary Corp
Computer Measurements
Datex Corp
Dynatronics Inc
Editape Co
Electrodata Div
Electronic Associates
Epsco Inc
Exline Engrg
Fischer & Porter Co
Friden Inc
Gerber Scientific Inst
Hanson-Gorrill-Brian
Hewlett-Packard
IBM Corp
Instrument Corp of Fla
Landis & Gyr
Monroe Components Div
Marquardt-Pomona Div
Northeastern Engrg
Philco Corp
Potter Instr Co
Presin Co
Standard Instrument
Streeter Amet
Stromberg-Carlson San Diego
Stromberg-Carlson Co
Technitrol Engrg
Telechrome Mfg Corp
Telecomputing Corp
Thompson-Ramo
Wang Laboratories

RECORDERS, Circular Chart (see also Object of Measurement)
Aeronaut & Instr Div
Automatic Timing & Contls
Bailey Meter Co
Barber-Colman
B-I-F Industries
Bristol Co
Defender Instrument
Electric Auto-Lite
Engler Instr
Fischer & Porter Co
Foxboro Company
Gerber Scientific Inst
Gilmore Industries
Hagan Chem & Contrls
Hays Corporation
Industrial Instr Corp
InstruLab Inc
Leeds & Northrup
Mason Neilan
M-H Brown Instrs Div
Powers Regulator
Research Inc
Schaevitz Engineering
Taylor Instrument
Weksler Instruments
Westinghouse Electric
Weston Instruments

RECORDERS, Electrosensitive
Century Elx & Instrs
Electro-Autosizing
Larson Instrument
Massa Div
Midwestern Instrs
Westronics Inc

RECORDERS, Magnetic Tape
American Electronics Inc
Ampex Corp
BJ Electronics
Bendix Computer Div
Camera Equipt Co
Consol Electrodynamics
Crump Instrument
Electronic Associates
Epsco Inc
Geneava Corp
Geotechnical Corp
Gordon Enterprises
Gulton Industries
Hermes Electronics
Houston Magnetic Prod's
Instrument Corp of Fla
Leach Corporation
Magnasync Mfg Co
Micronics Div
Midwestern Instrs
M-H Davies Labs Div
Packard Bell
Potter Instr Co
Radiaphone Co
Ramo-Wooldridge
Southwestern Indus Elx
Technitrol Engrg

RECORDERS, Multipoint
Atkins Technical Inc
Barber-Colman
Bristol Co
Consol Electrodynamics
Electro-Autosizing
Electro Instruments
Foxboro Company
GE Apparatus Sales Div
Gilmore Industries
InstruLab, Inc.
Offner Electronics Inc
Larson Instrument
M-H Brown Instrs Div
Research Appliance Co
Schaevitz Engineering
Taylor Instrument
Weston Instruments
Westronics Inc

RECORDERS, Strip Chart (see also the Object of Measurement)
Atkins Technical Inc
Automatic Timing & Contls
Barber-Colman
Bristol Co
Brush Instruments Div
Century Elx & Instrs
Consol Electrodynamics
Curtiss Wright
Electro-Autosizing
Electronic Associates
Esterline Angus
Fischer & Porter Co
Foxboro Company
GE Apparatus Sales Div
Geotechnical Corp
Gerber Scientific Inst
Gilmore Industries
InstruLab, Inc.
Larson Instrument
Leeds & Northrup
Link Aviation
Manning Maxwell & Moore
Massa Div
Midwestern Instrs
M-H Brown Instrs Div
Moore Products Co
Moseley Co F L
Norwood Controls
Offner Electronics Inc
Research Inc
Rust Industrial Co
Ryan Recording Thermom.
Sanborn Company
Schaevitz Engineering
Smith Inc Arthur F
Standard Instrument
Swartwout Co
Systron Corp
Taylor Instrument
Texas Instruments Inc
Varian Associates
West Instrument
Westinghouse Electric
Weston Instruments
Westronics Inc

RECORDING HEADS
Ampex Corp
BJ Electronics
Crump Instrument
Geneava Corp
Houston Magnetic Prods
Librascope Inc
Magnasync Mfg Co
Micronics Div
Midwestern Instrs
M-H Davies Labs Div
Monroe Electronics Div
Robins Industries
Southwestern Indus Elx

TAPE, Magnetic Recording
Accurate Specialties
Ampex Corp
Audio Devices
Minnesota Mining & Mfg

TELEGRAPHY, Automatic, including Reperforators, Tape Transmitters, Teleprinters, Teletypers
CGS Laboratories Inc
Editape Co
Ferranti Electric
P and H Electronics
Stelma Inc
Stromberg-Carlson San Diego
Telechrome Mfg Corp
Teletype Corp
Western Apparatus Co

CHRONO-LOG DIGITAL CLOCK

RELIABLE
FIELD-PROVEN
SMALL SIZE
LOW COST

Time resolutions of minutes, tenths of minutes or seconds.

Available with one parallel, binary-coded-decimal electrical output or up to three parallel, decimal electrical outputs.

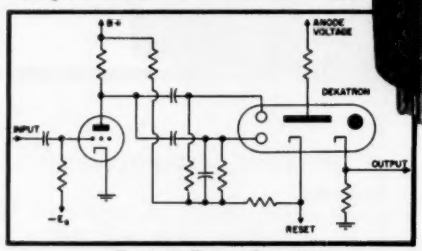
Flexible control features permit use of Chrono-log Digital Clocks and Digital Calendars in all logging, computing and programming systems.

CHRONO-LOG CORPORATION
Box 4587 Philadelphia 31, Penna.

CIRCLE 155 ON READER-SERVICE CARD

Simplify Circuitry using **dekatron®**

Electronic Counting Tubes (up to 20,000 counts/sec.)



Typical Drive Circuit

As a user of DEKATRON cold cathode glow-transfer counting tubes, you are welcome to use this and many other drive circuits designed by us. Circuits are patented (or applied for) but are available to DEKATRON customers.

Write to us for complete information.

Baird-Atomic, Inc.
33 UNIVERSITY RD., CAMBRIDGE 38, MASS.

Instrumentation for Better Analysis

CIRCLE 156 ON READER-SERVICE CARD

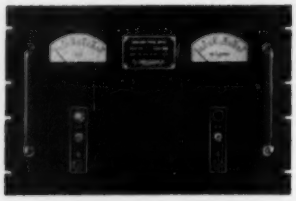
Electrical / Electronic

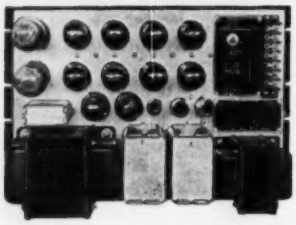
1960 BUYERS' GUIDE

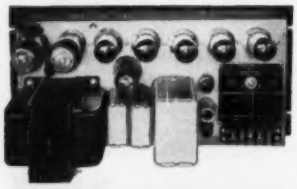
3

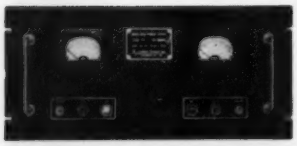
ELECTRICAL AND ELECTRONIC MEASURING AND TESTING EQUIPMENT

POWER SUPPLIES









VOLTAGE REGULATED POWER SUPPLIES

Featuring

- .05% regulation for load or line variations
- 500 microvolts ripple
- 50 microseconds response time
- 10-turn voltage controls for minimum noise
- Karma (20-PPM) wire wound, low t.c. error sensing resistors
- 50 hour pre-aging
- Meters included in feed back loop for low low output impedance
- Separately fused line and load circuits
- Separate AC and DC switches
- JAN quality components
- Input: 105-125 v. 55-65 cy. single phase
- 28 Models available from stock

POWER DESIGNS INC. *presents*

SEMICONDUCTORIZED POWER SUPPLIES

featuring

ROBOTEC • HEATRAN • VOLTRAN PROTECTION

Power Designs' *Semiconductorized* Power Supplies utilize the unique properties of semiconductor devices to create new circuit concepts achieving performance, efficiency and reliability hitherto unattainable. These instruments are NOT the conventional transistorized versions of vacuum tube regulators.

ROBOTEC*

is an inherent electronic circuit producing simultaneous voltage and current cutoff upon external short circuit. The "ROBOTEC" circuit operates in 30 microseconds holding the power supply cut off until manually reset and reducing line input power to a negligible value. If an external short circuit exists the power supply cannot be turned on.

HEATRAN†

is a transistorized circuit continuously monitoring dissipation in the series power transistors of the regulator system. Dissipation above a preset maximum value is automatically transferred into external vitreous enamel resistors extending from the rear of the equipment in a perforated metal cage. "HEATRAN" thus permits fewer transistors for a given power supply capacity, more compact equipment with increased reliability and practical convection cooling.

VOLTRAN†

is a transistorized circuit continuously monitoring the voltage drop in the series power transistors of the regulator system. Voltages above a preset maximum are instantaneously absorbed thus protecting these transistors against line and load transients and permitting more conservative voltage derating.

*U.S. PATENT PENDING
†U.S. PAT. APPLIED FOR

Type A

MODEL 1515
1-15VDC • 0-1.5A
$159.50

MODEL 1515A
1-15VDC • 0-1.5A
$174.50

Type E

MODEL 3206
1-32VDC • 0-600MA
$174.50

MODEL 2050
1-20VDC • 5A
$289.50

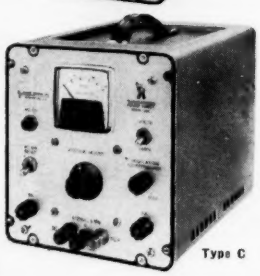
MODEL 1210
1-12VDC • 0-10A
$349.50

MODEL 1010T
1-100VDC • 0-1A
$374.50

MODEL 3240
1-32VDC • 0-4A
$349.50

MODEL 105TA
1-100DVC • 0-500MA
$239.50

MODEL 5015
1-50VDC • 0-1.5A
$249.50



Type C

Dual Voltammeter on all models except model 1515

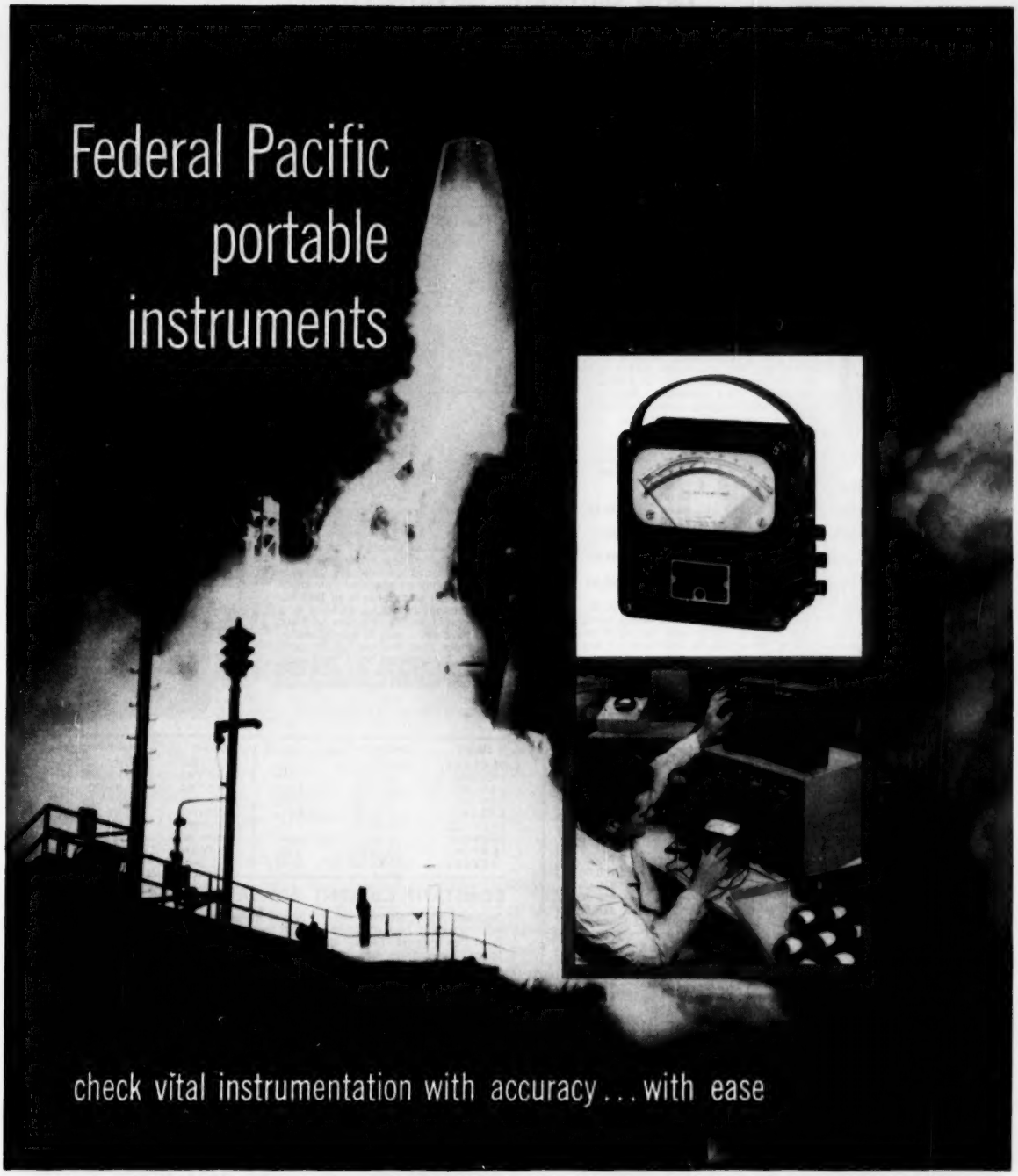
INPUT: 105-125VAC 55-440 Cy
REGULATION: .05%
RIPPLE: Model 1515, 1515A: 250 Microvolts
All Others—1.0 Millivolt
Internal Imp: Model 2050, 1210, 1010T, 3240; .005 ohms
All Others—.01 ohms

Rack Panel Adapters for Types A and B: Single Model RRA-15 $15.50, Dual Model RRB-15 $15.50. Rack Panel Adapters for Type C: Single Model RRA-20 $17.50, Dual Model RRB-20 $17.50. **F.O.B. Westbury, N. Y. Terms, ½% 10. Net 30 days. Prices subject to change without notice. Input: 105-125 v. 55-440—1ϕ

Recognized Reliability *Power Designs inc.*

1701 Shames Drive, Westbury, N.Y.
Phone: EDgewood 3-6200

CIRCLE 158 ON READER-SERVICE CARD



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The Best in Electrical Distribution and Control Equipment

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FROM MILLIWATTS TO KILOWATTS

HIGH VOLTAGE POWER SUPPLIES AND EQUIPMENT

We have sold quantities of these power supplies to laboratories, industrial concerns, the government and universities. Only the best available selected material goes into these units, so that you will have many years of dependable service. Only a few of our standard models are shown below. Quotations on special supplies cheerfully given.

PRECISE MEASUREMENTS COMPANY

HIGH VOLTAGE POWER SUPPLIES

One of the most popular power supplies on the market. Completely redesigned for greater ruggedness and convenience of operation. Widely used for powering electronic equipment and for routine breakdown and insulation testing. Output voltage is well filtered D.C. which is adjustable with convenient front panel control. Input is 115 Volt, 60 cycle A.C. Equipment is available without meter, with one meter (4½"), with two meters, or with larger 6" precision 1% mirror scale movement. Regulated models offer closely stabilized output voltage regardless of line or load changes.

Model		Maximum Voltage	Price	Price Regulated Model
6001	With Kilovolt Meter	1,000	$ 75.00	
6000		2,500	60.00	
6000-A	With Kilovolt Meter	2,500	80.00	$120.00
6005		5,000	75.00	
6005-A	With Kilovolt Meter	5,000	95.00	135.00
6010		10,000	85.00	
6010-A	With Kilovolt Meter	10,000	105.00	145.00
6015		15,000	95.00	
6015-A	With Kilovolt Meter	15,000	115.00	155.00
6025-A	With Kilovolt Meter	25,000	175.00	205.00

MIRROR SCALE HIGHER ACCURACY METERS: Recommended where more exact settings or measurements are needed. Meter size has been increased to 6 inches for easier reading. Price $35.00 additional on any meter equipped model.
TWO METER MODEL ..... ADD $35.00

INDUSTRIAL POWER SUPPLIES

These industrial type power supplies are built for service and efficiency. All are of the transformer type and employ husky components that have been selected for their power handling capacity. Controls are arranged so that operation is greatly simplified and a number of safety features are built in for maximum protection of personnel and equipment. Output is continuously variable from zero to full rated value. Polarity reversing models (as illustrated) can be had at additional cost.

Model	Voltage	Current	Price
F-500V	0-500	3 Amp	$800.00
F-6001	0-1000	2 Amp	975.00
F-6002	0-2000	1 Amp	985.00
F-6003-A1	0-3000	100 MA	375.00
F-6003-AV	0-3000	500 MA	550.00
F-6003-AK	0-3000	1 Amp	1100.00
F-6005-A1-H	0-5000	100 MA	550.00
F-6005-AV	0-5000	500 MA	750.00
F-6005-A1K	0-5000	1 Amp	1200.00
F-6010-A1	0-10,000	100 MA	800.00
F-6020-A05	0-20,000	50 MA	975.00
F-6050-T	0-50,000	½ MA	600.00
F-6100-T	0-100,000	½ MA	1100.00

Regulated Types Available

Standard hum level 5% or less. .01% to 1% ripple available. All power supplies have automatic overload cutout control circuits. Regulated models available.

HEAVY DUTY POWER SUPPLIES

For use in applications where high voltages at extra high currents are required. Illustrated is our 100 KW Model, rated for 0 to 7,000 Volts at 14 Amperes DC. This unit is housed in a single convenient cabinet. Output voltage is regulated against line and load changes. Voltage is smoothly adjustable from zero to full output. Automatic circuits protect against overvoltage or over current conditions, turning off main power in a split second. Use of special transformer construction allows constant load drain at full rated output. All power supplies in this series are available with fixed or adjustable output and with or without regulation.

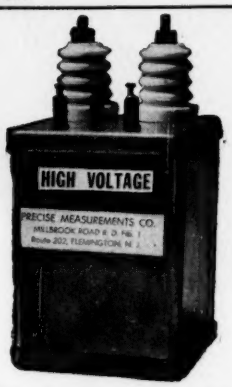
Model	Voltage	Current
A-10	0-1000	5 amperes
A-30	0-3000	5 amperes
A-31	0-3000	10 amperes
A-32	0-3000	20 amperes
A-50	0-5000	5 amperes
A-51	0-5000	10 amperes
A-72	0-7000	15 amperes
A-100	0-10,000	5 amperes
A-110	0-10,000	10 amperes
A-300	0-30,000	5 amperes

TRANSFORMERS, HIGH VOLTAGE

For experimental, industrial or production applications. These units are small and compact and rated for constant service. Primary designed for 105/115/125 Volts 60 Cycle. Secondary winding has half voltage tap. Only standard models are listed, other voltages and currents available on order.

Model	Voltage	Model	Voltage
1 KVT	1 KV	10 KVT	10 KV
2 KVT	2 KV	15 KVT	15 KV
3 KVT	3 KV	25 KVT	25 KV
5 KVT	5 KV	50 KVT	50 KV

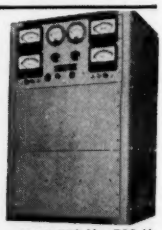
PACKAGED POWER SUPPLIES



These conveniently packaged power units will be found ideal for applications requiring minimum size and weight. Features isolated high voltage terminals permitting either the positive or negative side to be grounded. Rectifier tubes are operated from separate filament transformers so that DC output voltage can be varied from zero to full rated value. Selenium rectifier types have extra cells to assure operation under high line voltage or light loading. All standard units have well filtered DC output. Power packs with AC output available on order.

Model	Output Voltage	Current	Model	Output Voltage	Current
05-KV-5MA	500 Volts DC	5 Ma.	20-KV-1MA	20 KV DC	1 Ma.
1-KV-5MA	1 KV DC	5 Ma.	20-KV-5MA	20 KV DC	5 Ma.
2-KV-5MA	2 KV DC	5 Ma.	30-KV-1MA	30 KV DC	1 Ma.
5-KV-1MA	5 KV DC	1 Ma.	30-KV-5MA	30 KV DC	5 Ma.
5-KV-5MA	5 KV DC	5 Ma.	50-KV-1MA	50 KV DC	1 Ma.
10-KV-1MA	10 KV DC	1 Ma.	50-KV-5MA	50 KV DC	5 Ma.
10-KV-5MA	10 KV DC	5 Ma.	75-KV-1MA	75 KV DC	1 Ma.
15-KV-1MA	15 KV DC	1 Ma.	100-KV-1MA	100 KV DC	1 Ma.
15-KV-5MA	15 KV DC	5 Ma.			

CONSTANT CURRENT POWER SUPPLIES



Designed for application where output current must remain constant regardless of loading resistance changes. Used for magnet fields, plating applications, gaseous lamps. Dependable magnetic current stabilizer has no moving parts, no tubes, no transistors to replace. Simply set current to desired level, no balancing or other adjustments needed. Ideal for lamp operation since operating state ionizing voltage in no way affects lamp current. Standard hum level 5%. Lower hum levels available on order.

Model	Maximum Voltage	Maximum Current
C-25-700	25 Volts	700 Amperes
C-70-70	70 Volts	70 Amperes
C-500-10	500 Volts	10 Amperes
C-Duel 500-10	500 or 1,000 Volts	10 or 20 Amperes
C-800-2	800 Volts	2 Amperes
C-1000-100	1000 Volts	100 Amperes

Duel 500 V - 500 V, 10 Ampere Power Supply. Isolated outputs may be seried or paralleled.

AC INSULATION AND BREAKDOWN TESTERS

Used in testing insulation where AC voltages are desired. Dual instruments are also available which provide choice of AC or DC output with simple toggle switch selection. Units include kilovoltmeter, current meter and automatic overload cutout circuits.

Model	Voltage	VA	AC	AC and DC Price
3000	0 to 3,000	75	$150.00	$ 250.00
3010	0 to 3,000	300	250.00	400.00
3050	0 to 3,000	1,500	500.00	650.00
3100	0 to 6,000	3,000	700.00	1,100.00
5000	0 to 5,000	75	175.00	300.00
10K	0 to 10,000	75	200.00	350.00

PRECISE MEASUREMENTS COMPANY

MILLBROOK STREET • R. D. 1 • FLEMINGTON, NEW JERSEY • TEL. STate 2-2100

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RUGGED
PORTABLE PACKAGE

Announcing . . . A NEW IMPEDANCE BRIDGE

A Completely New Design to Replace A Famous G-R "Workhorse"

- ★ Bridge is battery operated and completely self contained — has built-in transistorized 1-kc oscillator and selective detector; meter null indication for both ac and dc. Total battery drain is less than 10 ma, providing 1-yr. life for typical laboratory use.
- ★ Orthonull*—a new, unique mechanical ganging of bridge's variable elements permits measurements to be made *without annoying sliding balances.*
- ★ Wide range — to 1000 μf, 1000 h, and 10 MΩ.
- ★ Accuracy holds over all ranges — not reduced at range extremes.
- ★ Provision for applying up to 600v dc to capacitors and small currents to inductors for polarization purposes and measurements at various d-c levels.

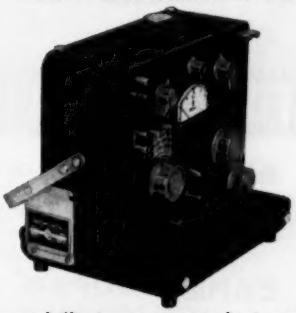
PARAMETER	RANGE	ACCURACY
Resistance, AC and DC (External DC required above 100 k Ω)	0.001 Ω to 10 M Ω 8 ranges	±1% ± 0.001 Ω (residual R ≤ 1 m Ω)
Capacitance, series or parallel	1 μμf to 1000 μf 7 ranges	±1% ± 1 μμf (residual C ≤ 0.5 μμf)
Inductance, series or parallel	1 μh to 1000 h 7 ranges	±1% ± 1 μh (residual L ≤ 0.2 μh)
D (for series capacitance case)	0.001 to 1 at 1 kc	±5% ± 0.001 at 1 kc
D (for parallel capacitance case)	0.1 to 50 at 1 kc	±5%
Q (for series inductance case)	0.02 to 10 at 1 kc	±5%
Q (for parallel inductance case)	1 to 1000 at 1 kc	for 1/Q ±5% ± 0.001 at 1 kc

FREQUENCY RANGE: (1-kc supplied internally)
1% accuracy for L and C from 20c to 20 kc
1% accuracy for R from 20c to 5 kc
D and Q ranges are direct reading at 1kc

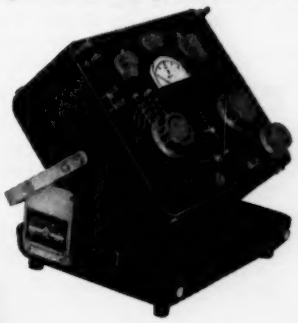
Type 1650-A Impedance Bridge . . . $440.

Type 1650-P1 Test Jig, for convenient production testing . . . $19.00.

. . . provides protection in transit and convenience in use



. . . panel tilts to any convenient angle



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GENERAL RADIO COMPANY

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SYSTEMATS®—The up-to-date custom approach to multi-function monitoring. Any number of modules may be mixed or matched. Built to industrial or military standards and uses PANELSCOPES as building blocks.

PANELSCOPES®—Standard and custom designed panel mounted oscilloscopes in modular form of 5 9/16" x 5 1/4". Amplifiers from 2 1/2 mv/inch, up to 10 mc; triggered, repetitive or expanded sweeps; and automatic portrayal available. Rugged and military construction.

PANELPACKS®—Power supplies for PANELSCOPES and SYSTEMATS.

RAKSCOPES®—Standard and custom built rack mounted industrial and military type oscilloscopes.

PULSESCOPES®—A series of versatile pulse synchroscopes for Laboratory, Field and Airborne use.

CRAFTSCOPES®—A series of direct reading portable industrial oscilloscopes featuring 5-inch displays, small size (1/2 to 3/4 cu. ft.) and weights as low as 18 lbs.

POCKETSCOPES®—A series of extremely portable time-tested industrial oscilloscopes less than 1/4 cu. ft. and weight as low as 8 lbs. with wide performance specifications.

RAYONIC® CATHODE RAY TUBES—A complete line of 3-inch and 5-inch tubes made to EIA or MIL specs. with rectangular and round cross sections. Tube lengths: from 7 inches. P1, P2, P7, P11 and special phosphors available.

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Carrying Cases
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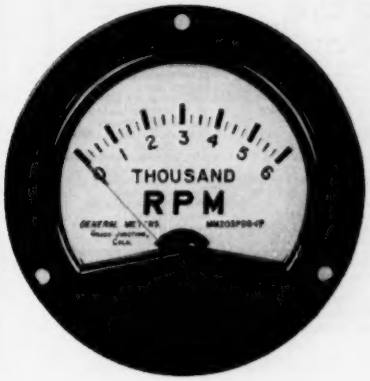
General METERS

FOUR STAR QUALITY ★★★★

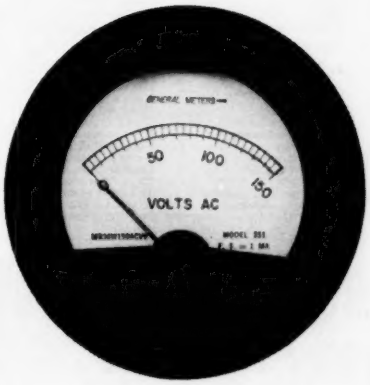
Model 410
4¼ Rectangular, Picture Window

Model 510
4⅝ Rectangular, Picture Window



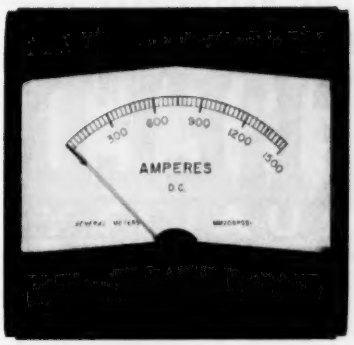
Model 200
2½" Dia.

Model 300
3½ Dia.



Model 202
2½" Dia.

Model 303
3½ Dia.
Hermetic Sealed



Model 400
4¼ Rectangular,

Model 500
4⅝ Rectangular

★ RUGGED CONSTRUCTION THROUGHOUT
★ "ISOGUARD" GUARDED JEWELS
★ PRECISION MACHINED POLES AND FRAMES
★ EXTRA HIGH TORQUE MOVEMENT

In addition to "4 Star" Features General Meters include: **Unitized frame structure, ⅛ inch antistatic glass windows, alnico 5 magnets, high strength coil bobbins, tubular aluminum alloy pointers. Bonded vinyl faced dials, 3 point magnet supports, ¼% linearity, 1% accuracy if requested, 2% standard.**

General Meters produces custom meters to order as well as stock instruments. The four photographs shown above are representative of our styling which covers meters in the 2½" round, square, hermetically sealed and ruggedized; 3½" round, square hermetically sealed and ruggedized; 4¼" rectangular, 4¼" picture window, 4⅝" rectangular and 4⅝" picture window.

General METERS, INC.

P. O. BOX 1701 — GRAND JUNCTION, COLORADO

CIRCLE 164 ON READER-SERVICE CARD

AMMETERS, AC and/or DC, Single or Multi-range, Indicating, Clamp Type, Contact-making, Laboratory Standard, Recording, Split Core

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Beckman/Helipot Div
Beede Electrical Instr
Bristol Co
British Industries
Columbia Electric
Curtiss-Wright
DeJur Amsco
Electric Auto-Lite
Electric Dev & Mfg
Epic Inc
Esterline Angus
Federal Pacific
Fox Valley Instr
GE Apparatus Sales Div
Greibach Instrument
Hewlett-Packard
Hickok Electrical Instr
Martindale Electric
Meters Inc
Parker Electronics
Physics Research Labs
Q. V. S. Inc
Sanborn Company
Sensitive Research Instr
Simpson Electric
Sticht Co Herman
Sunshine Scientific
Technique Associates
Texas Instruments Inc
Triplett Electl Instr
WacLine Inc
Waldom Electronics
Welch Scientific
Westinghouse Electric
Weston Instruments

AMMETERS, Microammeters and Milliammeters

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Beckman/Helipot Div
Beede Electrical Instr
British Industries
Burton-Rogers
Curtiss-Wright
DeJur Amsco
Electric Dev & Mfg
Electronic Instrument
Epic Inc
Esterline Angus
Federal Pacific
GE Apparatus Sales Div
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Hewlett-Packard
Hewson Co Inc
Hickok Electrical Instr
Ideal Precision Meter
Martindale Electric
Meters Inc
Millivac Instr Div
M-H Marion Instr Div
Parker Electronics
Physics Research Labs
Q. V. S. Inc.
Sensitive Research Instr
Simpson Electric
Sunshine Scientific
Tektronics Lab
Triplett Electl Instr
WacLine Inc
Waldom Electronics
Welch Scientific
Westinghouse Electric
Weston Instruments

AMPEREHOUR METERS

Hickok Electrical Instr
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Sangamo Electric Co

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Astra Technical Instr
Audio Instrument Co
Automatic Timing & Contls
Autotron Inc
Beva Laboratory
Boonton Electronics
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Bulova Research
Bulow Electric
Calif Magnetic Control
Carruthers & Fernandez
Centralab Div
Century Elx & Instrs
Chesapeake Instr
Chicago Std Transformer
Coast Coil
Collins Radio
Communication Accessories
Communication Meas Lab
Consol Electrodynamics
Control Technology
Cooper Development
Cox Instruments
Curtiss-Wright
D & R Ltd
Dalmotor Div
Daytronic Corp
Designs for Tomorrow
Dian Laboratories
DI/An Controls
DJECO
Donner Scientific
Dukane Corp
Dynamics Instrumentation
Elcor Inc
Electro Instruments
Electro-Mechanical Res
Electro Precision
Electrol
Electronic Associates
Electronic Computer Co
Electronic Instrument
Electronic Tube
Electronics International
Electrosolids Corp
Engineered Electronics
Entron Inc
Epsco Inc
Erie Resistor
Fairfield Engrg
Feedback Controls Inc
Foxboro Company
Freed Transformer
GPE Controls
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General Devices
Geotechnical Corp
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General Mills Inc
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Hamner Electronics
Hays Corporation
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Hoover Electronics
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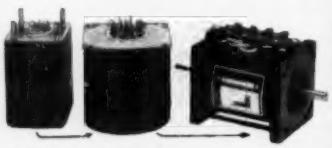

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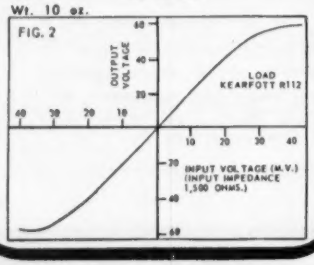

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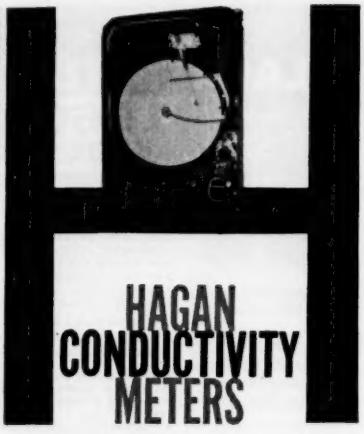

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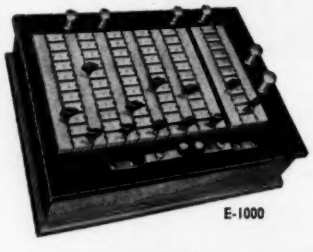

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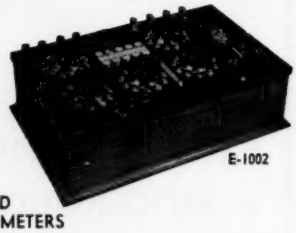

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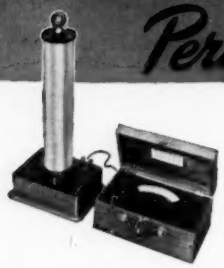

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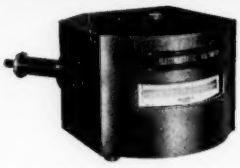

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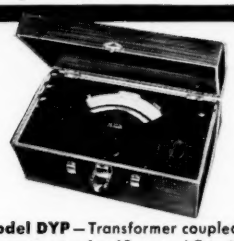

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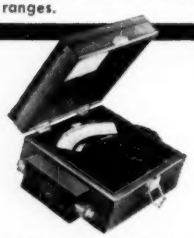
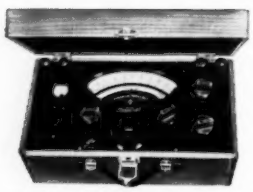


Model XT—R.F. ammeter. Accuracy —1% f.s. DC to 70 Mc. Single range from 1 amp. to 100 amps. (higher on special order). Automatic Temperature Compensation. 6.3" scale. **Model RF**—same, but ranges 1 ma. to 1 amp. f.s. Frequency – 1 Mc. (4 range unit 250 kc.). **Model AU** – Accuracy-.5% (on special order) up to 20 kc.

Model A—Accuracy—.75% f.s. (.5% on special order). Single or multirange switch controlled f.s. ranges from 1 ma. to 1.5 amps.; .2 v. to 1.5 kv. Frequency – up to 7 kc. on E; 15 kc. on I. Automatic Temperature Compensation. 6.3" scale. Thermocouple instruments are available with a thermocouple replacement feature and overload protective shunt.

Model RFV—Radio frequency voltmeter. Accuracy – .5% f.s. ± .5% max. frequency influence on switch controlled multirange units from 1 v. (5 Mc.) to 300v. f.s. (150 kc.). Single range instruments of 1v. or 3 v. f.s. have an upper frequency limit of 10 Mc. Automatic Temperature Compensation. 6.3" scale. Can be certified on DC. Frequency influence constant.

DC CORROSION AND ELECTROLYSIS INSTRUMENTS



Model PV – Potentiometer voltmeter – measures *true potentials* with zero current drain. Accuracy – .5% f.s. Multirange combs. from 2 mv. to 20 v. f.s. 5.2" scale. **Model ZR**—Zero resistance micro-milliammeter having a zero volt loss. Accuracy—.5% f.s. Multirange combs. from 10 μa. to 300 ma.

Model HS-COR – Designed for rugged field use for A. T. & T. and Bell Tel. Labs. Accuracy – .5% f.s. Multirange combs. from 5 mv. to 100 v. Sensitivities to 1 megohm/v. 6.3" scale. Features the *formica case, Diamond Pivots, and special non-slip binding posts for alligator clips.*

Diamond Pivots and shock mounted jewels are included in all Laboratory Standards and ultra high sensitivity instruments (thermocouple meters, low resistance microammeters, etc.) They are many times more shock resistant than conventional pivots and jewels, and their installation assures a friction free moving element under the severest operating conditions.

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SENSITIVE RESEARCH

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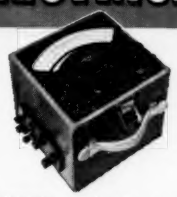
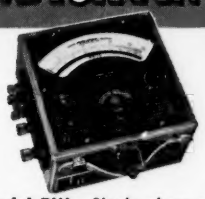
ELECTRICAL INDICATING INSTRUMENTS

AC-DC WATTMETERS



Model PDLW — Polyphase wattmeter for use down to 20% p.f. Accuracy—.75% f.s. up to 500 c.p.s. Multirange combs. from 1.5 w. to 2.4 kw. f.s. at 75/150/300 v. f.s. (frequency limits of 2.5 kc. on special order) 5.2" scale. **Model PDW** — same, but accuracy — .25% f.s. down to 50% p.f. and up to 800 c.p.s. Ranges from 15 w. f.s. at 50/100/200 v. f.s. 6.3" scale.



Model DW — Single phase reference standard wattmeter. Accuracy — .25% f.s. to 50% p.f. and up to 800 c.p.s. Multirange combs. from 5 w. to 2 kw. f.s. at 50/100/200 v. f.s. 6.3" scale. **Model DLW**—same, but accuracy .5% f.s. down to 20% p.f. and up to 500 c.p.s. Ranges from .2 w. f.s. at 75/150/300 v. **University Model** — same, but 4" scale and reduced accuracy.

Model VAW — Volt-Amp-Wattmeter. AC. Accuracy—.5% f.s. for E. and I.; .75% f.s. for w. Ranges for "50-800 c.p.s." model—50/100/200/250/500 w.; 1/2/2.5/5 kw. f.s. at 100/200/500 v. f.s. down to 50% p.f.; "50-125 c.p.s." model has additional ranges of 12.5/25 w. f.s. and 25/50 v. f.s.

AC-DC VOLTMETERS AND AMMETERS

A *NEW* portable Field instrument

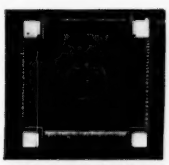
Model N — Economically priced, rugged DC and AC voltmeters and ammeters. Accuracy — .5% f.s. Switch controlled. Range combs. — 50 mv. to 1.5 kv. (up to 5 k.-ohms/v.); 50 μa. to 50 amps. DC; 5 v. to 750 v.; 10 ma. to 10 amps. AC. *Long 6" scale.* Moulded bakelite case with carrying strap. *Can be supplied for panel mounting.*

Portable double pivoted D'Arsonval,[1] dynamometer,[2] and moving iron[3] instruments. Single and multirange. Switch controlled to 5 amps. and 1 kv. Self-contained to approximately 20 amps. and 1.5 kv. (DCHI to 30 kv.)

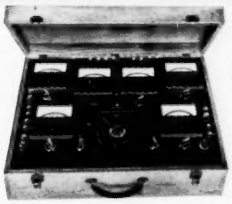
UNIVERSITY MODEL

Model	*Accuracy*	*Scale*	*F.S. Ranges Start At*
[1]C	.25% f.s.	6.3"	DC 30 μa; 50 mv.
[1]S	.5% f.s.	6.3"	DC 1 μa; 1 mv.
[1]UNIV.	.5% f.s.	4"	DC 2 μa; 1 mv.
[1]DCHI	1% f.s.	4"	DC 1.5 kv. 50k Ω/v.
[2]D	.25% f.s.	6.3"	AC/DC 5 ma; 1.5 v.
[2]UNIV.	.5% f.s.	4"	AC/DC 10 ma; 7.5 v.
[3]MI	.5% f.s.	6.3"	AC 10 ma; 7.5 v.

MAGNETIC TESTING INSTRUMENTS



EPSTEIN FRAME



Model MAT

Test set, designed in accordance with ASTM specifications (sec. A341-49 and A343-49), for core loss measurements, determination of hysteresis loops and magnetization curves, magnetic field and AC permeability tests. Inductors above and below 1 amp. available. Includes automatic internal power compensation circuit. Contains a DC ammeter, AC ammeter, RMS voltmeter, flux voltmeter, low p.f. wattmeter, and fluxmeter with convenient overlapping ranges. **Model COL** — core loss test set with special .25% f.s. accurate flux voltmeter (6.3" scale), RMS voltmeter, ammeter and wattmeter.

Model FM — a zero torque multirange fluxmeter calibrated in maxwells. Reads changes in flux linkage of a search coil as it moves in a magnetic field. Accuracy—.5% f.s. Sensitivity 1000 lines/div. using standard 10 turn search coil (1000 turn coil = 10 lines/div.). 5.2" scale. **Calibrated search coil and magnet** available for certification purposes.

AC-DC PANEL INSTRUMENTS

SRIC instruments have hand-drawn mirrored scales, electrostatic and magnetic shielding and temperature compensation. Portables in general conform to ASA specs C39.1-1951 for either .25% or .5% class instruments. *All SRIC products are calibrated against primary standards that have National Bureau of Standards Certificates of Accuracy and are unconditionally guaranteed for materials and workmanship for a period of one year.*

Model JWSP

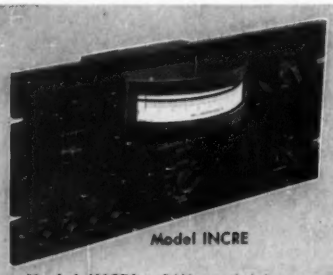
TYPE EW CASE

All of the models described in this brochure, and in our complete catalog, are available as edgewise panel instruments with *no loss in accuracy or sensitivity.* Scale lengths — 5" (type EW-5) and 7" (type EW-7). Switch controlled. Single or multirange. In some cases, such as polyrangers, they are supplied mounted in standard 19" rack panels. **Model JW** — Accuracy — .5% f.s. Max. of 3 DC ranges (B.P.'s only) from 2 μa, and 1.5 mv. f.s. Scale 4". ***New* Model JWSP** — same, but can contain up to 10 switch controlled ranges. **Rectangular DC and AC models** available at accuracies from .5% to 1% f.s.

INSTRUMENT CORPORATION

ELECTRICAL INSTRUMENTS OF PRECISION SINCE 1927

SPECIAL INSTRUMENTS
by SENSITIVE RESEARCH



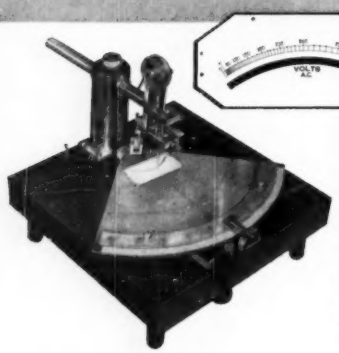
Model INCRE

Standard Volt

Model INCRE — Differential Incremeter. ***A NEW .05% f.s. accurate expanded scale DC standard*** for rock panel mounting or portable use. Combines the high comparison accuracy of the differential instrument with a .005% stable source. Scale has an effective length of 63" or 70", and a resolution of 1000 divisions. Each 10% of any range is expanded over the instrument's *actual* 6.3" or 7" scale length. Direct reading! No balancing or nulling! Single or multirange combinations from 200 μa. to 10 amps. and 200 m.v. to 1 kv. **The Standard Volt** is the internal source used, and is available separately. Input 115 v. 60c.p.s. 25 va. Output 1.0 v. and 1.0185 v. to within .01%. (Exact E. can be certified to .001%).

Model RA measures the ratio of 2 DC currents or voltages. Accuracy — .25% max. Minimum current per coil 50 μa. Scale reads 0 to ∞. Special scales as required.

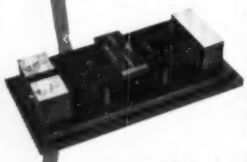
Model FRE — Frequency meter. Accuracy — .25% of center frequency (expanded scale), or of f.s. value (zero left). Ranges e.g.; 54 — 66 c.p.s.; 350-450 c.p.s.; or 0-100 c.p.s. f.s. Nominal input 115 v. and/or 230 v. ±15%. 6.3" scale.



MODEL SCAMA — SCALE DRAWING MACHINE used to manually draw and print any flat electrical indicating instrument scale where the angular deflection of the instrument's pointer is no greater than 110° (adapter available for arcs of 270°). This unit is a duplicate of those we have used in our laboratory since 1927 and is capable of drawing precision scales to all the accuracy that the resolution of an instrument will permit.

INSTRUMENT ACCESSORIES

VACUUM THERMOCOUPLES (Instrument type)—Sensitivities from 1 ma. to 1 amp. Output approximately 8-10 mv. open circuit. UHF types. Isolated or contact heaters. Special long-time constants. AIR COUPLES to 100 amps. (higher on special order).



LABORATORY STANDARD SHUNTS—Accuracy—.1% or .05%. Potential drop 50 mv., 100 mv., or 300 mv. Values from 1 amp. to 1000 amps. Rated for continuous duty.

MULTIPLIERS—Available to extend voltage ranges of all instruments. Accuracy — .1% or .05%.

FORMICA CASES are available for all portable instruments normally supplied in a wood case. They are structurally strong, a good dust and humidity barrier, and will look like new for the life of the instrument.

MODEL STC — Miniature Standard Cell. Accuracy — .025%. Nominal output 1.0185 v.

Specifications subject to change without notice.

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SENSITIVE RESEARCH INSTRUMENT CORPORATION

NEW ROCHELLE, N. Y.

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CONDUCTIVITY METERS

- Laboratory Conductivity Bridges—Type RC
- Solu-Bridge—Type RD
- Solu-Bridge Controller—Type RE
- Self-balancing Indicator-Controller—Type RI

Also

Recording instruments for all conductivity applications in both line and battery powered types.

Write for complete catalog

Industrial Instruments inc.

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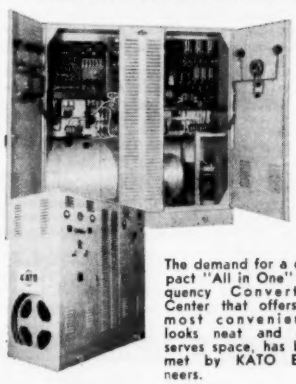
CIRCLE 177 ON READER-SERVICE CARD

FULLY HOUSED FREQUENCY CONVERTING SYSTEM!



The demand for a compact "All in One" Frequency Converting Center that offers utmost convenience, looks neat and conserves space, has been met by KATO Engineers.

Housed within this cabinet are a KATO MOTOR Generator and all the necessary controls that include the KATO manufactured "REGOCITER", static exciter regulator as well as reduced voltage synchronous motor starter.

KATO'S SYSTEMS APPROACH to power conversion offers the advantage of the size and type of motor generator set with the necessary controls to meet your exacting requirements.

A COMPLETE LINE OF AC GENERATORS ADAPTABLE TO ANY INDUSTRIAL ENGINE.

WRITE FOR DETAILS!

KATO *Engineering Company*

1490 FIRST AVE., MANKATO, MINNESOTA

Builders of Fine Rotary Electrical Machinery Since 1928

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← CIRCLE 176 ON READER-SERVICE CARD

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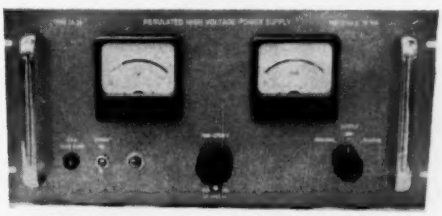
DAMPOMETER SYSTEMS

with automatic printout and automatic cycling.

The only instrument especially built for mass producing damping data.



MODEL LS-25 POWER SUPPLY

provides stable and easily-variable high-voltage for measurements involving especially photomultipliers

One ten turn range from 750-2750 volts at 25 mils.

Combined polarity and on-off switch operable under load.

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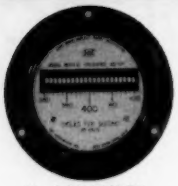
CIRCLE 179 ON READER-SERVICE CARD

REED FREQUENCY METERS • ELAPSED TIME METERS
TOGGLE, LEVER and ROTARY SWITCHES of Instrument and Test Equipment Quality for THE ELECTRONIC INDUSTRY

CONTINUED ON NEXT PAGE ➡

Model 30-F
Dual Range, Double Window



Model 36-FX-21
21-Reed Meter in 3½" Case

Model 34-FHXX-11
11-Reed in 3½" Sealed Case

MS35058-21

ST27N

Model 41-FX-42
300—500 cycles and
380—420 cycles, 4" case.

Model 15-FHAC
2-Reed in 1½" Sealed Case

Model 33-FP-9M
TS-328 A/U (400 cy. type)

MS35059-27

MS25068-27

VIBRATING REED FREQUENCY METERS

Meters illustrated are used wherever constant or known frequency is important to efficient operation of equipment.

- ***Permanently Accurate*** **within ±0.3% or better at reference temperature, depending on the model. This accuracy is not affected by poor wave form, external magnetic disturbances, or voltage fluctuations.**
- ***Size and Type for Every Service.*** **Made in many portable and panel styles and reed groupings; 12-650 cycles and above.**
- ***Rugged Construction*** **of simplified, patented design, with no moving parts to wear out or get out of calibration.**
- ***Suitable for Electronic Circuits.*** **Power consumption is comparatively low, and J-B-T reeds have high Q with prompt, sharp response.**

3½", 2½" and 1½" SEALED Types

3½" FHXX Meters, sealed glass-to-metal construction with solder terminals, meet or exceed the sealing, mounting and electrical requirements of JAN-1-6 and MIL-M-6A, including the 3000 volt breakdown. Barrel diameters, $2^{11}/_{16}$" —overall depth behind flange, $2^{7}/_{8}$"... New 2½" Models 21-FHXX and 23-FHXX now are cataloged... The 1½" Sealed Size is illustrated by Model 15-FHAC, above, 60 and 400 cycles, 2 reeds, 8-10 volts, for cathode follower circuits as in standardizing output of audio oscillators... also 15-FH Series, 5 reed, 58-62 cycles, 100-130 volts, or 390-410 cycles, 110-130 volts. Barrel, 1½" dia., detachable flange, 2.094" dia., solder terminals.

REED RELAYS AND TACHOMETERS

Please give circuit requirements when requesting quotations on J-B-T *reed relays* and *oscillator controls:* (1) plug-in can type which responds to or controls respectively a transmitted signal such as 200 cycles in mobile or other communications equipment; (2) a new type relay, patent pending, which has no vibrating reed contacts, and often needs no further signal amplification. This device also will be made as a *frequency limit control* with reed indication.

For *tachometers* to read r.p.m. by resonance alone—no electrical or complicated mechanical connections—request Bulletin MT-458.

ASK FOR CATALOG 558-B

ELAPSED TIME METERS

For Maintenance, Tube Life and Operating or Test Time Records; Model 31-ES, 3" rectangular case (illustrated) registers in 1/10 hour steps to 9,999.9 hours, then resets automatically. Most popular, Model 31-EX (3½" round case) normally is stocked for 60 cycles, 100-130 volts. Variations such as 50 cycle; 230 volts; 0-99,999 hours; readings in minutes; 2½" clear-plastic rectangular case—are available on special order.

SEALED ELAPSED TIME METERS

60 or 50 cycle, Model 31-EHXX, same as 31-EX above but fully sealed, with glass-to-metal construction, solder terminals, and 3½" detachable flange to match XX metal frequency meter case. 1000 volt breakdown—Model 21-EHXX, 2½" sealed 60 cycle meter has full size counter 400 cycle, Model 33-EHXX, 110-125 volts, has same sealed construction, but 2¾" barrel dia., 4" deep behind panel.

FREQUENCY—ELAPSED TIME METERS

One combination meter saves panel space and does the work of two. Model 31-FE (illustrated) has 3¼" flange, metal case $4^{1}/_{32}$" deep; 5 reeds, 58-62 cycles. On special order 7, 9, or 11 reeds, or 50 cycles, or 3½" case (known as 31-FEX-1) can be supplied.

DISTRIBUTOR SERVICE

Standard J-B-T items are available through authorized electronics parts distributors.

TOGGLE SWITCHES AN, JAN, or MIL

More than 140 models of exceptional-quality toggle switches, all designed for Government specifications, now are manufactured by J-B-T. The heavy-duty models feature solid coin-silver contacts, unique to J-B-T, which add overload protection and keep contact resistance under .005 ohms. Nominal ratings are 20 amp. at 125 VAC, 10 amp. at 250 VAC, unless otherwise indicated.

ST40, 42, 50, 52 series—Single-pole and double-pole, heavy-duty, for JAN-S-23, MIL-S-21195A (Ships), and Ordnance Standards DDAX. Solder and screw terminals.

MS35058, 35059 series—Lever seal for sand, dust, and 15 ft. water submersion tests; single-pole, double-pole, heavy-duty for MIL-S-3950A (significantly modifying MIL-S-3950). Specification covers screw terminals with solderable finish.

MS25068 series—Four-pole, with lever seal, heavy-duty types; 8 models for MIL-S-3950A. Screw terminals with solderable finish.

AN3021, 3027 series—Aircraft types with lever seal, single-pole and double-pole, heavy-duty, for MIL-S-6745. Screw terminals.

ST12, 13, 16, 17, 22, 23, 26, 27 series—Medium-duty types, for JAN-S-23, MIL-S-21195A (Ships), Ordnance Stds. DDAX. Double-grip, self-cleaning contacts; current-carrying parts heavily silver-plated. Threaded bushings are $2^{3}/_{64}$" or ¼" long; solder terminals, rear or side-connected. Nominal rating 6 amp., at 125 VAC 3 amp., 250 VAC.

MS25098, 25100 series—Medium-duty types, single-pole, double-pole, for MIL-S-3950A, with lever seal for sand, dust, and 15 ft. water submersion tests. Threaded bushings $2^{3}/_{64}$"; solder terminal connections at rear. Nominal rating 6 amp. at 125 VAC, 3 amp. 250 VAC.

Design Note—MIL-S-3950A is the latest and most comprehensive specification. It ultimately is expected to supplant most of the other specifications.

For further technical information, please request Bulletin TS-6B.

ROTARY SWITCHES

MOLDED

For dependable performance in quality test equipment, instruments, inspection setups, and avionics, J-B-T makes 3 compact types—the 14 pos. (2" dia.) MS-14 molded series or the SS-14 laminated series, and the 20 pos. ($2^{23}/_{32}$" dia.) MS-20 molded series... Available in 1 to 6 decks (more on special order), shorting or nonshorting. The molded MS-14-2 is shown.

CONTINUED ON NEXT PAGE ➡

J-B-T INSTRUMENTS, INC. NEW HAVEN 8, CONN.

CIRCLE 180 ON READER-SERVICE CARD

Laminated Construction

LAMINATED

The 14 pos. rotary switches (SS-14-2 illustrated) are conservatively rated for carrying 1 amp., 125 volts AC, inductive load; maximum momentary (not make-and-break), 5 amp.; maximum voltage between contacts and ground, 1500 volts R.M.S.; between decks and ground, 2000 volts R.M.S. Average contact resistance is 0.007 ohms or less.

SOME NEW IDEAS IN SWITCHES

Bonded Construction

Ruggedized versions of the MS-14 and MS-20 molded switches may be ordered with bonded construction as MS-14B- or MS-20B- . Thus, a 14 pos. two-deck switch is MS-14B-2. Cured laminations bond the adjacent decks for ruggedization, shock-proofing, and further enclosure. The additional cost of this feature is moderate.

6-POLE DOUBLE-THROW PER DECK

Double-throw switching, 6 circuits per deck, becomes easy with this variation of the MS-20 switch. The illustration shows the internal construction of MS-20-1-6DT with back protective cover cut away. As in all J-B-T molded switches, sturdy construction features include 3-post deck suspension, double-grip collector arms, rectangular drive shaft thru decks for reliable indexing, and heavy, fine-silver plating for 100 hour salt spray test.

RING-CONTACT to Eliminate Soldering

Molded MS-14R- (per print SK-88) and MS-20R- (per print SK-89) switches are available on special order with the outside edge of all contacts held together by an integral ring as illustrated in the MS-20BR-1 (which coincidentally is bonded). The exclusive ring construction eliminates the need for soldering jumpers between adjacent contact positions and assures excellent connections. The rings, which add 7/32" to the O.D. of the switch, can be easily cut out between contacts, making this type excellent for development work or assembly savings.

NEW ENCAPSULATED (XX) TYPE

In response to requests for extra-high reliability switches which are vaportight and fully encapsulated, J-B-T is producing on a custom basis switches of the MS-14XX- (diameter 2⅜") and MS-20XX- series. Please request sketch SK-107 and data on properties of encapsulation material. Gland-sealed shaft and rear connections by coded wire, pins, or AN connector, will be quoted on request.

LEVER ACTION SWITCHES

Model MS-20-1L5A-1 (illustrated) provides 5 live positions, 2 circuits per deck, in a molded body. Ten other 3 and 4 position lever switches use the same top-quality parts as laminated SS-14 switches. For ganged-lever switches request print SK-74 on the SSG types, in 3, 4, or 5 positions, 2-10 decks.

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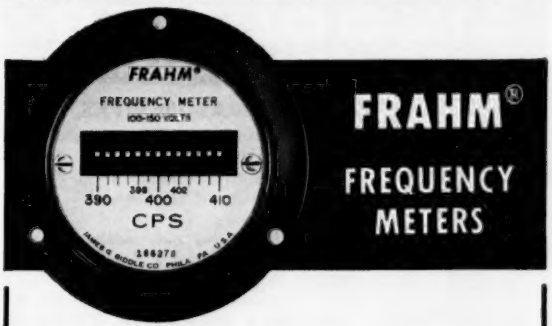

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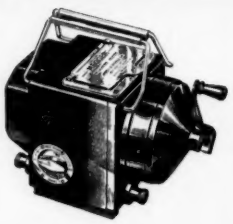

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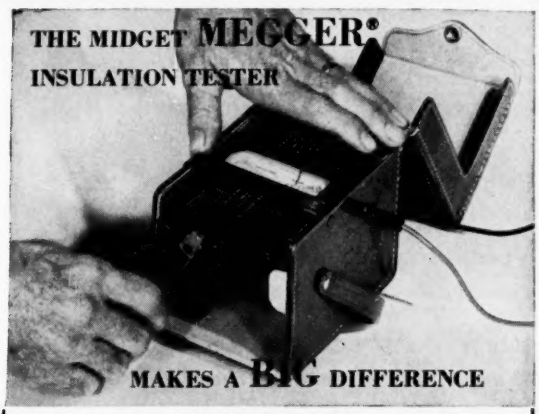

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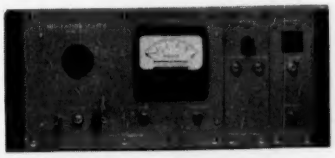

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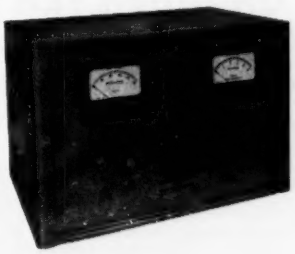

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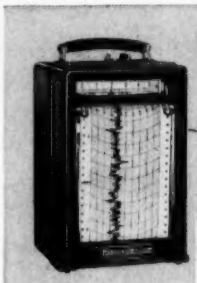

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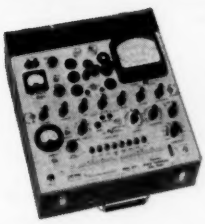

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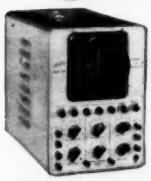
OSCILLOSCOPES

WIDE RANGE—VERSATILE
MODEL 1810—5" flat face, post accelerated CRT and illuminated, calibrated screen. 4 mc band vertical amplifier. 10 millivolts peak-to-peak per cm sensitivity. Triggered or recurrent sweeps—variable from 2 cps to 30 kc. Built-in, direct reading, regulated square wave voltage calibrator. AC or DC vertical amplifier inputs.



INDUSTRIAL'S 5" PORTABLE
MODEL 685—Features identical amplifiers DC to 750 kc—1 cps to 750 kc. 0.5 microseconds rise time. Sensitivity—20 millivolts RMS vertical (30 horizontal). Recurrent or triggered sweep. Covers 1 cps to 10 kc in 5 calibrated decade ranges with vernier control of 10 to 1. External sync for triggering and synchronizing the built-in sweep generator.

3" RACK MOUNT
MODEL 387R—Identical horizontal and vertical amplifiers. Triggered or recurrent sweeps from 1 cps to 100 kc. Slow sweeps (10 seconds or more) with external capacitors. 10 millivolts RMS per inch vertical sensitivity (14 horizontal).

3" PORTABLE
MODEL 385 CSM—Rugged lightweight designed for field service. Features unitized circuit modules. DC amplifiers (horizontal and vertical) with frequency coverage to 4 mc at .075 RMS volts per inch. 2 MC bandwidth has roll-off per IRE standard. Telescopic light shield and shock mounted carrying case.

CARD PROGRAMMED SWITCH
Cardmatic automatic or manual multiple switch provides up to 10-trillion variables. Self-cleaning, wiping type contacts rated .00025 ohms nominal (contact-to-pin), current rating is 10 amperes. Prox. 7" x 7½" x 4½" D.

GENERATORS

SINE WAVE—SQUARE WAVE
MODEL 710—Both sine and square wave outputs in one generator with wide frequency range (20 cps to 1 megacycle in 5 ranges). Sine wave total harmonic distortion below 1%. Hum level better than 90 db down. Square wave rise time less than 0.1 microsecond. Portable—easily adapted to rack mount.

SQUARE WAVE
MODEL 1715—Wide frequency range of 1 cps to 1 megacycle, continuous in 6 decade bands with constantly variable frequency available throughout the entire range. Rise time is 0.02 microseconds. Consistent output level is independent of frequency setting. Electronic regulation of power supply. Includes symmetry control and provision for external synchronization.

VACUUM TUBE VOLTMETERS

HIGH FREQUENCY MODEL
MODEL 1600—Accurately indicates AC voltages from .05 to 300 volts in frequencies from 20 cps to 700 mc (useable to 3000 mc). Includes special thermionic diode probe. Plus or minus DC volts, excellent readability from .05 to 1000 volts. 7-range ohmmeter with practical readability from 0.2 ohm to 1000 megohms. Power supply built-in. Has 1% meter.

SMALL SIZE VOM
MODEL 456—Has full-wave bridge type rectifier circuit. Features a patented automatic (button-reset) overload protection system to hold meter and associated circuits from damage due to accidental overload. 0-1200 AC or DC volts in 6 ranges. Sensitivity—20,000 ohms per volt DC (1000 AC). Resistance—0 to 100 megohms. 5 db ranges (−18 to +57).

HICKOK-DAWE INSTRUMENTS

True RMS-VTVM—300 microvolts to 300 volts, 5 cps to 500 kc.

Stroboscopes—3 models with wide ranges.

Sound Level Indicators—Portable and laboratory types.

Balancing Machine—For rotating parts (4 oz. to 10 lbs.).

HICKOK METERS
Accurate DC and AC Portables

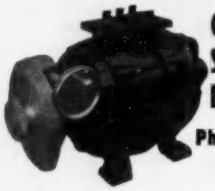
Ammeters, milliammeters, microammeters, voltmeters, millivoltmeters, volt-ammeters, thermometers. Shielded. Accuracy within ½ of 1%—available to 2/10 of 1%.

PANEL METERS
A complete panel meter line is available in numerous types, styles and ranges to meet every specification. The many special movements developed by HICKOK are: Electrodynamometers, self-contained frequency meters, galvanometers, true logarithmic deflections, ruggedized, long scale subminiatures, and taut-band suspensions with sensitivities to as low as 2 microamperes.

THE HICKOK ELECTRICAL INSTRUMENT CO.
10519 DUPONT AVENUE
CLEVELAND 8, OHIO

CIRCLE 193 ON READER-SERVICE CARD

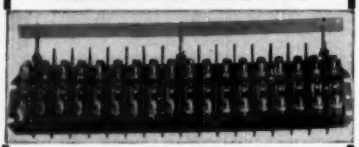
STATES
PHASE SHIFTERS



Quick
Safe
Economical
Phase Shifter
Type R

Made in 50 to 2500 volt ampere capacities. Provides means for shifting phase continuously for every possible angular displacement. May be obtained as combination of phase shifter and induction regulator.

TERMINAL BLOCKS



TYPE "NT" TERMINAL BLOCK
Sliding link feature. Any number poles desired. Test any circuit without removing permanent wiring.

THE STATES COMPANY
19A New Park Ave.
Hartford, Conn.

THE STATES COMPANY

CIRCLE 194 ON READER-SERVICE CARD

MODULATION INDICATORS
Instrument Corp of Fla
General Radio
Lampkin Labs
Marconi Instruments
Waterman Products
Weston Instruments

MODULATORS, MAGNETIC
ACDC Electronics Inc
Airpax Electronics
Brach Mfg Corp
General Magnetics
Kearfott Microwave Div
Magnetic Research Corp
Rixon Electronics
Varo Mfg Co

MULTIPLIERS, including High Voltage
British Industries
Davenport Mfg
Donner Scientific
Electronic Associates
Federal Pacific
General Devices
Manson Labs
Peschel Electronics
Phoenix Precision Instr
Reeves Instr Corp
Sensitive Research Instr
Weston Instruments
Wiancko Engrg Co

NETWORK ANALYZERS, Electric, Matching, Pulse Forming
ACDC Electronics Inc
Andersen Labs
Clegg Labs
Daven Co
Model Engrg
Rixon Electronics
Stelma Inc

NOISE FILTERS (see also Filters—Cat. 8)
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Airborne Accessories
Allen Business Machines
All-Tronics Inc
Bulova Research
Chicago Std Transformer
Globe Industries
Gudeman Co
Hughes Products
Intercontinental Elx
Kavamil Co
Kay Electric
Magnasync Mfg Co
North Hills Electric
Nuclear Chicago
Pacific Instrument Co
Packard Bell
Philco Corp
Rixon Electronics
Scott Inc H H
Sorensen & Co
Spectrum Instruments
Spencer-Kennedy Labs
Standard Electronics
Tobe Deutschmann Corp
United Transformer

NULL DETECTORS, Electrical
Acromag Inc
Beede Electrical Instr
Bergen Labs Inc
Boonton Electronics
British Industries
Bulova Research
Computer Instruments
Donner Scientific
Electro-Measurements
Federal Pacific
Fluke Mfg Co
Freed Transformer
General Radio
Hewlett-Packard
Houston Instrument
Hydel Inc
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Leeds & Northrup
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M-H Boston Div
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M-H Marion Instr Div
Muirhead Instrs Inc
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Shallcross Mfg Co
Telecomputing Corp
Weinschel Engrg
Weston Instruments
Winslow Company Inc

OSCILLATORS, Audio-frequency, Microwave, Radio-frequency, Ultrasonic
Acoustica Assoc
Airtronics Inc
Alfred Electronics
Allied Radio
Amerac Inc
Applied Radiation Corp
Arenberg Ultrasonic
Biddle Co James G
British Industries
Bulova Research
Calif Technical Indus
Canadian Marconi
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Kay Electric
Laboratory For Electronics
Leach Corporation
Manson Labs
Marconi Instruments
Midwestern Instrs
Muirhead Instrs Inc
Natl Ultrasonic
P and H Electronics
Philamon Labs Inc
Reeves-Hoffman Div
Riverbank Labs
Rixon Electronics
Sierra Electronic Corp
Solid State Electronics
Southwestern Indus Elx
Spectrum Instruments
Systron Corp
Technitrol Engrg
Telerad Mfg Corp
Teletronics Lab
Tel-Instrument Elx
Telonic Industries
Thomas Engrg Inc
Times Facsimile
Valpey Crystal Corp
Walkirt Co
Weinschel Engrg
Westamp Inc

OSCILLOGRAPHS, Moving-conductor
Century Elx & Instrs
Offner Electronics Inc

OSCILLOGRAPHS, Multi-element
Allegany Instrument
Brush Instruments Div
Century Elx & Instrs
Consol Electrodynamics
GE Apparatus Sales Div
Geotechnical Corp
Hamilton Watch Co
Hathaway Instrument Div
Midwestern Instrs
M-H Heiland Div
Offner Electronics Inc

OSCILLOGRAPHS, Recording
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Applied Science Corp
Brush Instruments Div
Century Elx & Instrs
Consol Electrodynamics
Crump Instrument
Electro-Medical Lab
Epic Inc
GE Apparatus Sales Div
Geotechnical Corp
Gerber Scientific Inst
Hughes Products
M-H Heiland Div
Gordon Enterprises
Hamilton Watch Co
Hathaway Instrument Div
Hughes Products
Massa Div
Midwestern Instrs
Moseley Co F L
Offner Electronics Inc
Sanborn Company
Southwestern Indus Elx

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American Electronic Labs
Canadian Marconi
Carol Electronics
DuMont Labs Allen B
Electro Instruments
Electronic Instrument
Electronic Tube
Feiler Engrg & Mfg
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Hickok Electrical Instr
Hughes Products
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Marconi Instruments
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Sierra Electronic Corp
Simpson Electric
Southwestern Indus Elx
Tektronix Inc
Trad Electronics
Triplett Electl Instr
Universal Match
Waterman Products

PERMEAMETERS, Magnetic
M-H Rubicon Instrs Div
Sensitive Research Instr
Sunshine Scientific

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Bowmar Instrument
Eastern Specialty Co
GE Apparatus Sales Div
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Muirhead Instrs Inc
North Atlantic Indus
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Sanborn Company
Systron Corp
Telechrome Mfg Corp
Theta Instrument
Western Electronic Prods
Weston Instruments

PHASE CONTROLLERS
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Electric Regulator
Fairfield Engrg
Hoffman Electronics
Rixon Electronics

PHASE SEQUENCE INDICATORS
Associated Research
Brunswick Instruments
Davenport Mfg
Eastern Specialty Co
Electric Regulator
GE Apparatus Sales Div
Knopp Inc
Master Specialties
Model Engrg
Opad Electric
Sticht Co Herman
United Mfg Co Div
Weston Instruments

PHASE SHIFTERS
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Aeronaut & Instr Div
Amer Meas & Control
Bogart Mfg Corp
Diamond Antenna
Diehl Mfg Co
Electronics International
Fairfield Engrg
Industrial Test Equip
Kearfott Microwave Div
Knopp Inc
Multi-Amp Electronic
Rantec Corp
Reeves Instr Corp
Rixon Electronics
States Company
Theta Instrument
Vectrol Engrg
Westinghouse Electric

POLARITY INDICATORS
Dice Co J W
Weston Instruments

POTENTIOMETERS, Manually-balanced
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Allegany Instrument
Beckman/Helipot Div
Borg Equipment Div
Bourns Inc
Carter Mfg
Clarostat Mfg
Electric Regulator
Electro-Measurements
Fairchild Controls
Fluke Mfg Co
Gray Instrument
Julie Research Labs
Kintronic Div
Leeds & Northrup
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M-H Rubicon Instrs Div
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Physics Research Labs
Precision Line Inc
Rinco Inc
Sensitive Research Instr
Servonic Instruments
Specialties Inc
Technique Associates
Thermo Electric
Weston Instruments
Winslow Company Inc

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Barber-Colman
Beckman/Helipot Div
Bristol Co
Centralab Div
Electric Regulator
Epic Inc
Foxboro Company
GE Apparatus Sales Div
Giannini Controls Corp
Gilmore Industries
Gulton Industries
Hays Corporation
Houston Instrument
InstruLab Inc
Leeds & Northrup
M-H Brown Instrs Div
Model Engrg
North Atlantic Indus
Servonic Instruments
Thermo Electric
West Instrument
Weston Instruments
Westronics Inc

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Esterline-Angus
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Fluke Mfg Co
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Physics Research Labs
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Westinghouse Electric
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PAT PEND
PHASE METER

MODEL 200AB

PRICE $419.00

- 2° absolute accuracy
- Readings not affected by noise and harmonics
- Frequency range 15 CPS — 30KC
- Accuracy to .01 degree with simple circuit techniques
- High sensitivity on input & reference channels
- Can measure in-phase & quadrature voltage component

For further information contact your nearest representative or write for brochure

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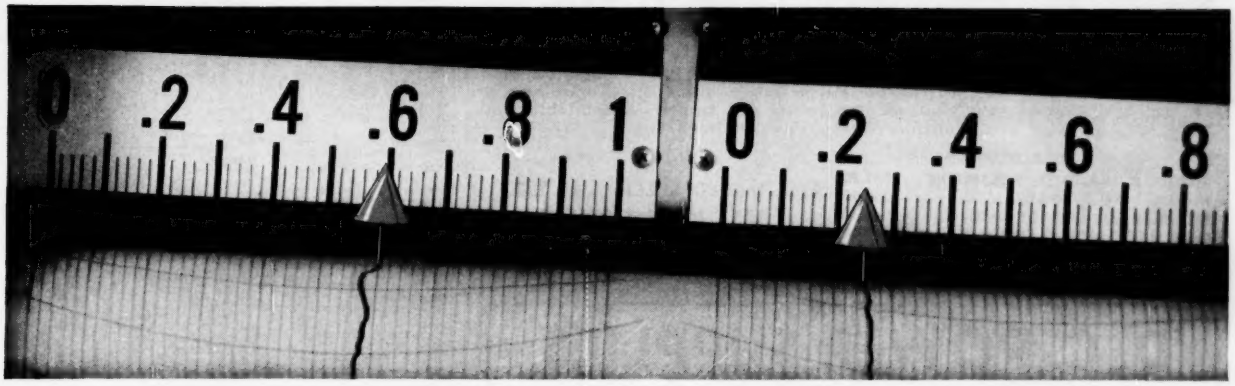
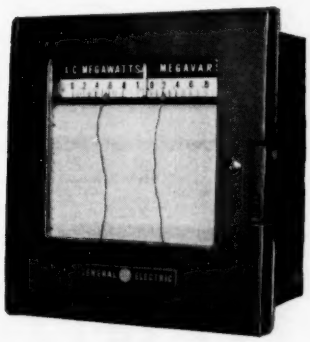
VISIT BOOTH #4, NEC CHICAGO
CIRCLE 195 ON READER-SERVICE CARD

plots twin records . . .





This new General Electric Type CH-37 duplex recorder plots two complete electrical records side by side on one ten-inch-wide chart. No more reading separate charts . . . now related functions such as watts and vars, volts and frequency, d-c amperes and speed can be measured and recorded with 1% accuracy on ***one strip chart.*** The CH-37 saves valuable panel space . . . it's only 15 inches wide by $16\frac{1}{16}$ inches high and semi-flush mounted. It features ***throw-away inkwell,*** multiple chart speeds, chart supply indicator, fluorescent-lighted chart face and gasket-sealed door with key lock. Companion models include a new narrow-range CH frequency recorder, self-contained and with accuracy of ±.05 cycles and range of only 58–62 cycles . . . and the CH-7 hook-on volt-ammeter, for accurate recording of dip and peaks on exacting maintenance jobs. Get the complete story on General Electric's line of CH recorders. Just call your nearby G-E Apparatus Sales Engineer or write direct to Section 592–201, General Electric Company, Schenectady 5, N. Y.

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The output voltage is continuously variable from 200 to 325 volts D.C. for load currents of 0 to 100 M.A. with an input voltage of 105 to 125 volts 60 cycle. Regulation is better than 1%. An isolated A.C. voltage of 6.3 volts at 3 amperes is available at the output terminal connections.

MODEL 3 ILLUSTRATED

MODEL 3 CAB. MTG., VOLTMETER	$69.50
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DUAL RACK MOUNT FOR MODEL 2 Mounts Two Model 2 Units in 8¾"	$9.00

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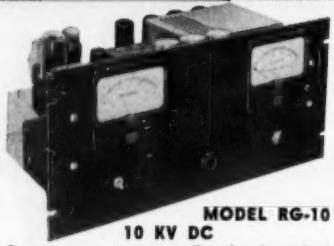
SPELLMAN HIGH VOLTAGE POWER SUPPLIES



MODEL RG-10
10 KV DC

Output current 2 ma.—Regulated against line and load 1%. Variable 8 to 12 KV. Complete with Current and Volt Meters .....$360 Net

MODEL RG-5, 5 KV DC

Output current 2 ma. Regulated against line and load 1%. Variable 4 to 6 KV. Complete with Current and Volt Meters .....$250 Net

MODEL RG-15, 15 KV DC

Output current 2 ma. Regulated against line and load 1%. Variable 13 to 17 KV. Complete with Current and Volt Meters .....$275 Net
DIMENSIONS: Panel Height 8¾", Width 19", Depth 11".

MODEL LAB-90
0-90 KV RF TYPE REGULATED DC POWER SUPPLY

Continuously variable 0 to 90 KV DC Power Supply. Output current .7 ma. at 90 KV. 1 ma. at 80 KV. 2 ma. from 40 KV down. Voltage regulations better than 1% throughout entire range. Dimensions in cabinet: 28" high x 21¾" wide x 18" deep. For rack mounting. Panel dimensions 19" wide x 26" high x 18" deep.
LAB-90 Complete with HV meter .....$900.00 Net
Specify polarity output—positive or negative.

MODEL 4575
5 KV POWER SUPPLY

For an output voltage of 5 KV DC at 1 milliampere, the low voltage input requirement is 250 V at 50 milliamperes. By varying the DC input the output voltage can be varied from approx. 1 KV to 7½ KV. Dimensions: 5⅝" high x 5" deep x 4¼" wide. In completely enclosed metal housing. .....$32.50 Net
Model 4575-2 Same as above with 2 ma. output at 5 KV. .....$42.50 Net
FOR REVERSIBLE POLARITY MODELS (floating secondary) add letters PN after number. .....$10.00 additional

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TABTRON®—TABPAK®—TABTRAN®—TABSTAT®
High Current Power Supplies
Five Year Guarantee**
Variable Stepless from Zero to Full Voltage DC
Full Wave Selenium or Silicon Rectifier,
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***Per Factory Warrantee* *Write Details*

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T612V12A*	0-8 or 0-16 VDC @ 12 Amps.	$37
T612V12ACC*	0-16 V @ 12 A 1½% Rip @ 5 A	$47
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T12V50AC5J	0-12 V @ 50 A/5% Rip/5% Reg	$225
T28V5A	0-28 WVDC @ 5 Amp	$87
T28V5ACC	Filtered (1% Ripple)	$84
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T28V12ACC	Filtered (1% Ripple)	$158
T28V12A2CC	Filtered (0.1% Ripple)	$223
T28V24A	0-28 WVDC at 24 Amp	$168
T28V24ACC	Filtered (1% Ripple)	$224
T28V50A	0-28 WVDC at 50 Amp	$306
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RT35V25ACC5J	0-35 V @ 25 A/1% Rip/± 5% Reg	$395
RT35V50A36SJ	0-35 V @ 50 A/2% R/± 5% Reg	$540
RT35V100A36SJ	0-35 V @ 100 A/2% R/± 5% Reg	$756
T130V5A	0-130 VDC @ 5 Amp	$225
T130V5ACC	Filtered (1% Ripple)	$275
T220V2ACC	0-220 V @ 2 Amp/2% Rip	$270

* 2" Meters: 5J/SILICON RECT; 36/208-230 VAC/36 / INPT

24-28VDC	CASED FILTERED RELAY SUPPLYS.	
B24VAR	24-28 VDC @ 1 Amp	$7.00
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B12V24A	$97	B28V50A	$235
B12V50A	$140	B28V100A	$405
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SILTAB® SILICON & TEKSEL® SELENIUM POWER RECTIFIERS
To Your Specs — All Types & Current Ranges!
Ratings Are for Continuous Duty & Convection Cooling

"SILTAB"® SILICON 350°C FINNED RECTIFIERS—CONVECTION COOLED!

MAX DC AMP	FULL WAVE BRIDGE 35VAC 32VDC	70VAC 62VDC	120VAC 125VDC	240VAC 250VDC	1400VAC 1260VDC	1600VAC 1000VDC
1	$4.20	$5.45	$6.15	$7.90		
2	5.30	6.75	7.60	9.90		
3	7.65	9.75	17.10	20.80		
6	9.80	13.50	15.40	35.00		
10	12.50	17.00	27.00	40.75		
20	22.00	31.50	31.50	68.50		
25	32.00	55.75	60.45	121.50		
50	84.15	110.30	130.60	174.75		
100	95.45	136.75	180.30	321.90		
150	145.00	170.00	206.00	350.00		
200	214.00	283.00	295.00	503.00		

"TEKSEL"® SELENIUM RECTIFIERS, ONE YEAR GUARANTEED!

MAX DC AMP	FULL WAVE BRIDGE 14VAC 14VDC	28VAC 28VDC	42VAC 42VDC	56VAC 56VDC	84VAC 84VDC	112VAC 100VDC
1	$2.30	$3.45	$4.30	$4.90	$8.75	
2	3.65	5.25	6.25	6.25	11.70	
6	4.40	11.40	11.75	16.00	24.85	
12	8.80	18.75	22.75	18.75	32.60	
24	12.80	25.30	37.45	49.50	62.00	
50	16.00	32.00	44.60	57.50	96.50	
100	33.45	63.75	121.50	135.75	227.00	

CONVECTION COOLED*

	18VCT Forced Air Cooling Rating 1 Amp	36VCT 217VDC
12VDC	$2.90	$16.00
†Silicon at 2.5X Amps.	3.60	21.90
*Selenium at 2.5X Amps. for Capacitive/Motor/Battery Loads.	4.70	47.60
	7.45	61.45
	10.10	169.60
	12.75	188.75
	24.90	398.90

3-Ø THREE PHASE FULL WAVE BRIDGE

DC AMP	36VAC 48VDC	105VAC 144VDC	185VAC 248VDC	208VAC 277VDC	416VAC 554VDC	480VAC 640VDC
6	20.80	40.75	68.30	74.75	122.50	163.00
10	35.00	68.30	121.50	174.75	274.90	350.00
20	68.30	121.50	174.75	274.90	522.50	680.00
50	121.50	174.75	274.90	522.50	963.15	1359
100	174.75	274.90	522.50	963.15	1820	2400
150	274.90	522.50	963.15	1820	3450	4600
200	522.50	963.15	1820	3450	6500	8600

3-Ø STAR C.T.

	10VCT 24VDC	18VCT 48VDC	36VCT 96VDC	72VCT 192VDC	144VCT 384VDC	288VCT 768VDC
12	$23.10	$37.00	$54.60	$137.30	$262.45	$513.90
24	37.00	54.60	137.30	262.45	513.90	963.80
50	54.60	137.30	262.45	513.90	963.80	1820
100	137.30	262.45	513.90	963.80	1820	3450
150	262.45	513.90	963.80	1820	3450	6500
200	513.90	963.80	1820	3450	6500	12000

W. CENTER TAP

DC AMP	18VCT 12VDC	36VCT 24VDC	72VCT 48VDC	144VCT 96VDC	288VCT 192VDC	576VCT 384VDC
6	$6.15	$7.90	$20.80	$35.00	$68.30	$121.50
10	7.60	9.90	35.00	68.30	121.50	174.75
20	17.10	20.80	40.75	68.30	174.75	321.90
50	24.90	35.00	68.30	121.50	321.90	522.50
100	35.45	40.75	68.30	174.75	522.50	963.15
150	60.45	68.30	121.50	321.90	963.15	1820
200	130.60	174.75	321.90	522.50	1820	3450
300	180.30	321.90	522.50	963.15	3450	6500
400	206.00	350.00	680.00	1359	4600	8600
600	295.00	503.00	1000	2400	6500	12000

"TABTRAN" UNIVERSAL RECTIFIER TRANSFORMERS Dsgnd for F.W.B., C.T. & H.W.

Sec'd Volts (DUAL: 0-9-15-18-& 0-9-15-18
Series Sec'ds 0-3-6-9-12-15-18-21-24-27-30-33-36 Volts.
Pri-115 VAC, *115 & 230 AC

TR4001	@	1 Amp per each Sec'd Windings	$4.75
TR4002	@	2 Amp per each Sec'd Windings	6.60
TR4003	@	5 Amp per each Sec'd Windings	8.70
TR4005	@	12 Amp per each Sec'd Windings	18.00
TR4006	@	24 Amp per each Sec'd Windings	33.75
TR4007*	@	50 Amp per each Sec'd Windings	54.00
TR4008*	@	100 Amp per each Sec'd Windings	106.00

† Wndgs. in Series at Amps Shown; Parallel Seeds @ 2X Amps

"TABTRAN" UNIVERSAL RECTIFIER CHOKES

CR6001	1 Amp, 0.1 Henrys 1.4 Ohm	$3.75
CR6002	2 Amp, 0.1 Henrys .07 Ohm	5.60
CR6007	4 Amp, .01 Henrys .1 Ohm	5.95
CR6003	5 Amp, .07 Henrys .6 Ohm	9.45
CR6004	12 Amp, .01 Henrys .1 Ohm	14.45
CR6005	24 Amp, .004 Henrys .025 Ohm	27.00
CR6006	50 Amp, .001 Henrys .001 Ohm	40.00

"TABCAP"® FILTER CAPACITORS

CE156M	6000 MFD 15 V Wkg	$2 each
CE502M	2000 MFD 50 V Wkg	$4 each
CE2005M	500 MFD 200 V Wkg	$6 each
Brackets for capacitors		25c each

"TABTRAN" ISOLATION & CONTROL XFMRS
Enclosed Power Type Elec/Static-Shielded
Primary 115/230V & Secondary 115/230V 1c 60 cys.
Also on SPECIAL ORDER 230/460V Specify!

TPP050/50W	$11	TPP075/75W	$13
TPP100/100W	$14	TPP150/150W	$17
TPP250/250W	$22	TPP500/500W	$32
TPP750/750W	$48	TPP1000/1KW	$48
TPP2000/2KW	$73	TPP3000/3KW	$98

TECHNICAL APPARATUS BUILDERS
109GB LIBERTY ST., N. Y. 6, N. Y.
ORDER THRU ELECTRONICS DISTRIBUTOR OR WRITE US FOR CATALOG & DETAILS

CIRCLE 201 ON READER-SERVICE CARD

0-32 V.D.C. ½% Ripple

Input: 115 V.A.C. 60 Cycles, Single Phase

Amps.	Model	Style	H	W	D	Fig.
5	KM75	Rack	8¾"	19"	9½"	D
	KM75B	Bench	9"	17"	9"	E
10	KM81	Rack	8¾"	19"	9½"	D
	KM81B	Bench	9"	17"	9"	E
20	KM87	Rack	8¾"	19"	9½"	D
	KM87B	Bench	10½"	22"	12"	F
40	KM93	Rack	12¼"	19"	13"	—
	KM93B	Bench	14"	22"	15"	B

FEATURES

- Vacuum Varnish Impregnated Magnetic Components.
- 4½" Rectangular 2% Accuracy, D.C. Panel Meters (3½" on small units).
- Controls include power switch, line and load fuses, pilot light, voltage control knob, output binding posts.
- Voltage Regulation: 1/10 Load 36 Volts
  Full Load 32 Volts
- Panel Type Carrying Handles.
- Convection Cooled Continuous Duty Ratings.

Bulletin No. 102

0-32 V.D.C. 4% Ripple

Input: 208 V.A.C. 60 Cycles, 3 Phase

Amps.	Model	Style	H	W	D	Fig.
100	FR100	Floor	46"	22"	18"	A
200	FR200	Floor	46"	22"	24"	A

FEATURES

- Fully Self-Protecting Circuit.
- Pushbutton Operated Magnetic Contactor.
- Indicating Type AC Input Fuses.
- Adjustable Overcurrent Control in D.C. Circuit.
- Thermal Overload Device on Rectifier.
- Overload Warning Light and Reset Button.
- 4½" Rectangular, 2% Accuracy Panel Meters.
- Low Voltage Regulation: Approx. 8%
- Ball Bearing Type Casters.
- Input Receptacle and Mating Plug.
- All receptacles, terminals and controls clearly designated.
- Budget Priced.

Bulletin No. 155

0-110 V.D.C. 1% Ripple

Input: 115 V.A.C. 60 Cycles, Single Phase

Amps.	Model	Style	H	W	D	Fig.
2.5	RS10	Rack	8¾"	19"	9½"	D
	RS10B	Bench	10½"	22"	12"	F
5	RS20	Rack	10½"	19"	13"	D
	RS20B	Bench	12¼"	22"	15"	F
10	RS30	Rack	12¼"	19"	13"	—
	RS30B	Bench	14"	22"	15"	B
20	RS40	Rack	17½"	19"	13"	—
	RS40B	Bench	19¼"	19"	15"	C

FEATURES

- Vacuum Varnish Impregnated Magnetic Components.
- Non-Aging Rectifiers (Germanium or Silicon).
- 4½" Rectangular 2% Accuracy D.C. Panel Meters (3½" on small units).
- Controls include Power Switch, Line and Load Fuses, Pilot Light, Voltage Control Knob and Output Binding Posts.
- Both D.C. Terminals above ground and isolated from A.C. Line.
- Panel Type Carrying Handles.
- Convection Cooled Continuous Duty Ratings.

Bulletin No. 204

TRANSISTOR REGULATED POWER SUPPLIES

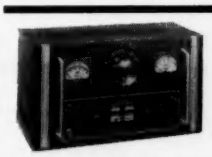
3-32 Volts D.C. ±½% Regulation*
Input: 105-125 volts A.C., 60-400 cycles, Single phase

Amps.	Model	Style	Amps.	Model	Style
1	TR10	Rack	10	TR30	Rack
1	TR10B	Bench	10	TR30B	Bench
5	TR20	Rack	15	TR40	Rack
5	TR20B	Bench	15	TR40B	Bench

FEATURES

- Zener Diode Reference.
- Ripple less than 5 M.V.
- Vacuum varnish impregnated magnetic components.
- Short Circuit Protection.
- Controls include power switch, fuses, pilot light, voltage control knob and output binding posts.
- 2% Accuracy Panel Meters.
- Both output terminals above ground and isolated from A.C. line.
- Panel type carrying handles.
- Continuous duty ratings.
- High efficiency.

*Line and Load



GENERAL PURPOSE UNITS

OUTPUT: 0-30 Volts D.C. Unfiltered Full Wave.

INPUT: 115 V.A.C., 60 Cy., 1 ϕ.

Model GM72 5 Amperes
Model GM78 10 Amperes
Model GM84 20 Amperes
Model GM90 50 Amperes

FEATURES: 2% accuracy Panel Meters, Line and Load Fuses, Switch, Pilot Light, Binding Posts.

Bulletin No. 179

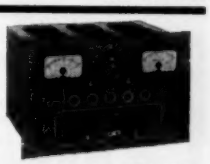
AIRCRAFT BATTERY SUBSTITUTE

OUTPUT: 0-30 V.D.C., 20 Amperes.
RIPPLE: Less than 1%.
INPUT: 115 V.A.C., 60 Cy., 1ϕ.
REGULATION: 1/10 Load 35 Volts
Full Load 30 Volts

FEATURES: Ammeter overcurrent protection circuit prevents needle 'slam' when starting inverters & motors

MODEL KM88 ...Rack Mount
MODEL KM88B...Bench

Bulletin No. 100



DUAL RANGE POWER SUPPLY

OUTPUT: 0-32/64 V.D.C., 40/20 Amps.
RIPPLE: Within 1% of aver. DC.
INPUT: 115 V.A.C., 60 Cy., 1 ϕ.
FEATURES: Thermal overload protection, indicating line and load fuses, overload warning light, dual range voltmeter.

MODEL KM95 ...Rack Mount
MODEL KM95B...Bench

Bulletin No. 183

OPAD ELECTRIC COMPANY
43-20 WALKER STREET • NEW YORK 13, N. Y.
Telephone WOrth 6-0380

CIRCLE 202 ON READER-SERVICE CARD

Cleaning Problem?

SONOGEN®

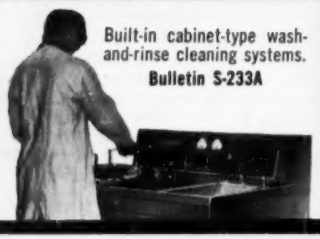
Ultrasonic Cleaners by

BRANSON

may be your answer!

½-gallon and larger benchtop models, and (illustrated) 5- and 12-gallon self-contained rollaround units.

Bulletin S-509, S-217B

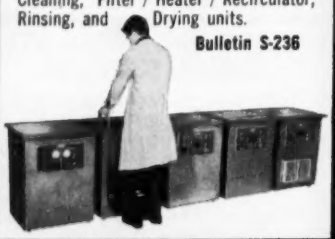


Built-in cabinet-type wash-and-rinse cleaning systems.

Bulletin S-233A

Modular cabinet-type systems with Cleaning, Filter / Heater / Recirculator, Rinsing, and Drying units.

Bulletin S-236



Custom-engineered cleaning installations: for batch and conveyorized cleaning, and for continuous-flow cleaning in strip and wire mills.

Bulletin S-235

Branson offers experienced counsel in adapting the flexibility of SONOGEN® Ultrasonic Cleaning Equipment to your needs. Tell us the problem, and we'll follow through from planning and installation to maintenance, with factory-trained specialists available nationwide.

Send Coupon to **BRANSON ULTRASONIC CORPORATION**
8 Brown House Road, Stamford, Connecticut

BRANSON: Send SONOGEN® Bulletin

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ADDRESS_____

CIRCLE 203 ON READER-SERVICE CARD

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Laboratory for Electronics
Millivac Instr Div
Model Engrg
Physics Research Labs
Simpson Electric
Slaughter Co Inc
Telerad Mfg Corp
WacLine Inc

PROJECTORS, Oscillogram

Gordon Enterprises

Q Meters

Canadian Marconi
Freed Transformer
Industrial Test Equip
Kay Electric
Marconi Instruments
North Hills Electric

RATIO BOXES

ACDC Electronics Inc
British Industries
Bytrex Corp
Coast Coil
Collins Corp G L
Electro-Measurements
Industrial Instruments
Muirhead Instrs Inc
Physics Research Labs
Planet Instrument
Rinco Inc
Winslow Company Inc

RELAY TESTERS

Abrams Instrument
Automation Controls Corp
Calif Technical Indus
Corbett Science Labs
Davenport Mfg
Dit Mco Inc
Eastern Specialty Co
Fleetwood Labs
Gulton Industries
Kahn & Co
Measurements Research
Multi-Amp Electronic
Naybor Labs E V
North Electric Co
Optimized Devices
Sel-Rex Corp
Sigma Instruments
Slaughter Co Inc
States Company
Sunshine Scientific
United Mfg Co Div

RESISTANCE BOXES, including Decade, Dividing, etc.

Aerovox Corp
Allied Radio
Arenberg Ultrasonic
British Industries
Bytrex Corp
Clarostat Mfg
Electro-Measurements
Electronic Instrument
Epic Inc
General Radio
Gray Instrument
Industrial Instruments
Julie Research Labs
Leeds & Northrup
M-H Rubicon Instrs Div
Muirhead Instrs Inc
Physics Research Labs
Pimex Inc
Precision Line Inc
Rinco Inc
Shallcross Mfg Co
Welch Scientific
Winslow Company Inc

RESISTANCE COMPARATORS

Bytrex Corp
Calif Technical Indus
Communication Meas Lab
Computer Instruments
Electro Instruments
General Radio
Industrial Instruments
Industrial Test Equipment
Julie Research Labs
Lavoie Labs
Measurements Research
Microloc Corp
Non-Linear Systems
Ruge Associates
Slaughter Co Inc
Western Electronic Prods

RESISTANCE INDICATORS, Ground, Insulation, Megohm, Milliohm, Ohm

Associated Research
Barber-Colman
British Industries
Bytrex Corp
Cubic Corp
Davenport Mfg
Datran Electronics
Dice Co J W
Dit-Mco Inc
Electro Instruments
Electronic Applications
Electronic Instrument
Federal Pacific
Freed Transformer
GE Apparatus Sales Div
General Radio
Greibach Instrument
Gulton Industries
Hewlett-Packard
Hewson Co Inc
Industrial Instruments
Lavoie Labs
Leeds & Northrup
Martindale Electric
Millivac Instr Div
Physics Research Labs
Simpson Electric
Slaughter Co Inc
Southwestern Indus Elx
Sticht Co Herman
Sunshine Scientific
Triplett Electl Instr
Weston Instruments
Westronics Inc
Winslow Company Inc

RESISTANCE RADIO BOXES

British Industries
Datran Electronics
Electro-Measurements
Gray Instrument
Industrial Instruments
Julie Research Labs
Leeds & Northrup
M-H Rubicon Instrs Div
Muirhead Instrs Inc
Physics Research Labs
Rinco Inc
Winslow Company Inc

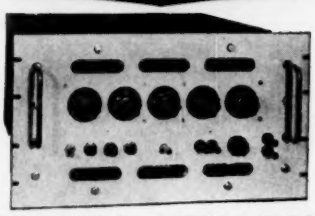
RESISTORS, Decade

Aerovox Corp
British Industries
Clarostat Mfg
Corbett Science Labs
Daven Co
Electro Instruments
Electro-Measurements
General Radio
Gray Instrument
Industrial Instruments
International Resistance
Julie Research Labs
Leeds & Northrup
M-H Rubicon Instrs Div
Muirhead Instrs Inc
Physics Research Labs
Precision Line Inc
Rinco Inc
Shallcross Mfg Co
Winslow Company Inc

SHUNTS, including Shunt Meters, Ayrton

Beede Electrical Instr
British Industries
Burton-Rogers
Esterline-Angus
Federal Pacific
GE Apparatus Sales Div
Gray Instrument
Leeds & Northrup
Meters Inc
M-H Rubicon Instrs Div
Physics Research Labs
Ram Meter Inc
Sensitive Research Instr
Shallcross Mfg Co
Simpson Electric
WacLine Inc

NORTH HILLS'



CURRENT GOVERNOR

Model CS-11

for *Constant Current*

- Precision Current Source
- Gyro Torquer Supply
- Transistor and Diode Tester

▸ *High Accuracy* ▸ *Excellent Stability* ▸ *Programmable*

For testing and measurement of gyros, transistors, diodes, clutches, solenoids, meters, other current sensitive devices.

- Current Range is 1μa to 100 ma with 5 decades — digital in-line readout —
- Regulation and stability 0.002% —
- Accuracy 0.02%

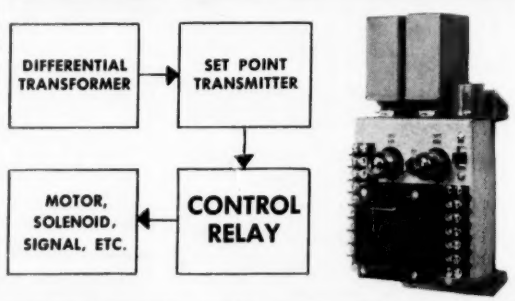
In use by leading companies for gyro torquer supply, transistor avalanche test, diode PIV test, clutch testing, calibration.

Literature describing this and other constant current sources from 0.1μa to 30 amp. may be obtained from

nh NORTH HILLS
ELECTRIC COMPANY, INC
402 SAGAMORE AVE., MINEOLA, N.Y. Pioneer 7-0555

CIRCLE 204 ON READER-SERVICE CARD

ATCOTRAN CONTROL RELAY



CONVERTS SENSING SIGNAL INTO SPDT SWITCH ACTION

Flexible and versatile building block for automatic control systems operates with Atcotran differential transformer in systems for sensing pressure, flow, force, level, weight, thickness, width, and other process variables.

Responds to 0.0001 inch armature displacement of differential transformer. Provides fast, dependable control of machine or process functions (linear displacement, machine tool motion, table indexing, package check weighing, liquid level measurement, etc.) Frictionless and temperature stable, utilizes service-free printed circuit.

Write for free literature on automatic control systems components.

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CIRCLE 205 ON READER-SERVICE CARD

Waldom Electronics
Westinghouse Electric
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Winslow Company Inc

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General Radio
Hickok Electrical Instr
Houston Instrument
Kay Electric
Mine Safety Appliances
M-H Davis Labs Div
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SOUND INDICATORS, including Noise Indicators and Noise Measuring Sets

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Kay Electric
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Erwood Inc
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Gulton Industries
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M-H Davies Labs Div
Model Engrg
Nuclear-Chicago
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SPECTRUM ANALYZERS, RF including Panoramic Adapters

Canadian Marconi
CGS Laboratories Inc
Model Engrg

STANDARDS, Acoustic

General Radio
Scott Inc H H

STANDARDS, Capacitance

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Electro-Measurements
General Radio
Leeds & Northrup
Industrial Instruments
Muirhead Instrs Inc
Winslow Company Inc

STANDARDS, Frequency, Inductance, Resistance, Shunt

Acton Laboratories
American Time Prod
Borg Equipment Div
British Industries
Canadian Marconi
Chesapeake Instr
Delta F Inc
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Electro-Measurements
Erie Resistor
Federal Pacific
General Radio
Geotechnical Corp
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Gyrex Corp
Hermes Electronics
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General Radio
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Baird-Atomic Inc
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Cubic Corp
Curtiss-Wright IMI
Dunn Engrg Assocs
Eder Engrg
Electric Hotpack
Electronic Instrument
GE Missile & Space Veh
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Kay Electric
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Sierra Electronic Corp
Stromberg-Carlson Co
Tech Apparatus Bldrs
Teletronics Lab
Triplett Electl Instr
Valor Instruments

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British Industries
Electronic Instrument
General Radio
Hewson Co Inc
Hickok Elcterical Instr
Manson Labs
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Arenberg Ultrasonic
Bendix Pioneer-Central
Branson Ultrasonic
Chesapeake Instr
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Interelectronics
Laboratory for Electronics
L and R Mfg Co
Magnaflux Corp
McKenna Labs
Narda Ultrasonic
Natl Ultrasonic
Spectrum Instruments
Sturrup Inc
Westinghouse Electric

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British Industries
Canadian Marconi
Carol Electronics
DuMont Labs Allen B
Electronic Instrument
Flow Corporation
Fluke Mfg Co
General Radio
Hewlett-Packard
Hickok Electrical Instr
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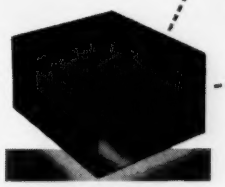
The NEW *Series* BH100

MILLI-V-METER*

DIGITAL READOUT

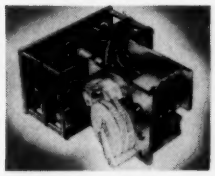
0001



ACCURACY 0.1%

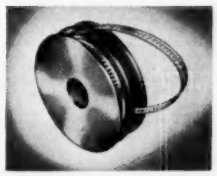
***SMALL SIZE** — This compact, transistorized, servo-driven instrument measures only 3 x 5 x 5¾".*

THE INSTRUMENT with the TAPE-SLIDEWIRE



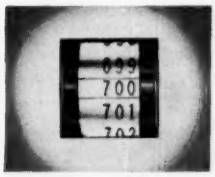
***ALL INCLUSIVE** — With Zener reference, power supply, amplifier, servo motor, 144" tape-slidewire.*

for FLOW · PRESSURE LEVEL · TEMPERATURE etc.



***TAPE-SLIDEWIRE** — Mounted on side-by-side spools, slidewire is embedded in edge of tape, punched for sprocket drive.*

- Every scale division is a calibrated point.
- 100 calibrated points per foot of slidewire length.
- Slidewires up to 12 feet long.



***PRINTED READOUT**—Calibration printed on tape available to measure steady-state conditions or where input deviates more than 13%.*

LINEAR, PARABOLIC, LOGARITHMIC FUNCTIONS ARE DISPLAYED IN DIRECT DIGITAL RELATION

*TRADE MARK

Full information is available for the asking!

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The Goerz electrodynamic precision instruments are available for measurement of current, voltage and power at an accuracy of ±0.2% of full scale. Special models offer current and voltage accuracies of ±0.2% up to 1000 c.p.s.; power accuracies of ±0.2% up to 500 c.p.s. A low power (10/50 ma — 150/300/450 v) instrument is available at ±0.5%. These instruments have been tested and certified by every major standards laboratory in the world. Each instrument is supplied with the manufacturer's certificate and calibration curve.

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edited by Aronson and Nelson. " . . . a practical text . . . covers fundamentals, basic bridge circuits, typical applications, and surveys typical commercial instruments which use or are used with strain gages." Paper, 110 pages, illustrated, indexed by company, author, and subject, 1958. **$2.00**

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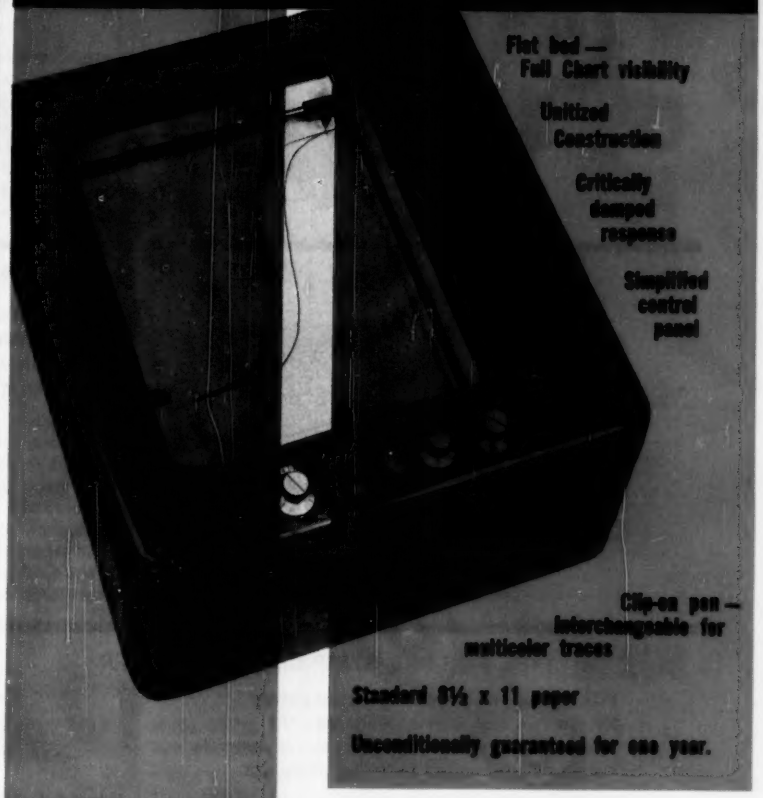
HR-92 X-Y RECORDER


Flat bed — Full Chart visibility
Unitized Construction
Critically damped response
Simplified control panel
Clip-on pen — interchangeable for multicolor traces
Standard 8½ x 11 paper
Unconditionally guaranteed for one year.

RUGGED "All Purpose" X-Y RECORDER

The HR-92 is a null-seeking servo-type plotter designed to draw curves in Cartesian coordinates on regular 8½ x 11 graph paper. It employs conventional chopper amplifiers, 2-phase motors and a potentiometer rebalance. Reference voltages are furnished by mercury cells. Control panel has zero set and continuously-variable attenuator for each axis. Separate standby and power switches are provided. The two axes are electrically and mechanically independent. By moving an internal jumper lead, a high impedance potentiometer input can be made available.

SPECIAL FEATURES:

- Amplifiers easily removed if servicing ever becomes necessary. Electrical connections all contained in two plugs for each amplifier.
- Each amplifier channel (including transformer power supply) independent of rest of system.

WRITE FOR:
New X-Y Recorder Circular #717-3 showing complete specifications and photographs.

houston instrument corporation
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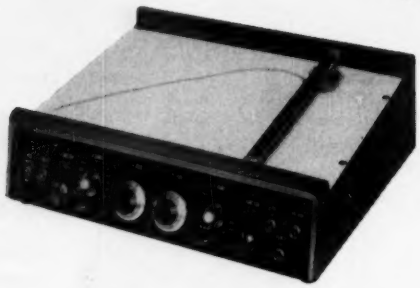
CIRCLE 208 ON READER-SERVICE CARD

MOSELEY AUTOGRAF

NEW MODEL 2D X-Y RECORDER



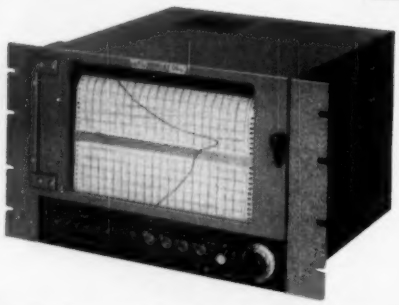
Integral AC/DC input
No extra AC converter needed
Built-in sweep circuit
Popular 11" x 17" size

with accessories including

Digital Character Printer, Curve Follower, Continuous-Roll Transport, "Tear-off" Chart Transport.

New Model 2D X-Y Recorder has an input range of 7.5 mv to 150 v on X-axis; 5 mv to 100 v on Y-axis; each in 10 steps. Input resistance 200,000 ohms/v; zero offset; accuracy and resolution of ± .2%. X-axis time base, 5 steps, 7.5 to 750 secs. Pen speed 20 in/sec; vacuum paper hold down. Variable range extender both axes.

NEW MODEL 80 STRIP-CHART RECORDER



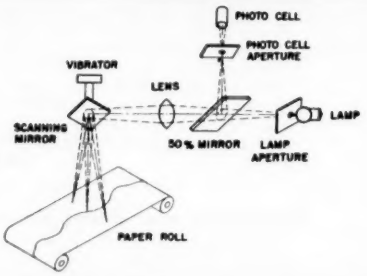
6 push-button variable chart speeds
Transistor speed switching; no gears
Local or remote chart and pen control
Roll-out carriage simplifies chart change

New precision laboratory strip-chart recorder providing instantaneous control of all functions; employing standard 120' chart rolls. Input ranges 5 mv to 100 v, with 10 calibrated steps plus continuous vernier span control. Full range zero set; input resistance 200,000 ohms/v through 10 v; 2 megohms on higher ranges. Sensitivity 0.05% full scale, resolution and accuracy 0.2%. Pen speed (max.) ¼ second full scale, chart speeds 2, 4, 6, 8, 15 and 60 in/min; other speed groups available.

NEW TYPE F-2 LONG STRIP CURVE FOLLOWER

Tracks, converts trace to electrical energy
No metallic inks or re-drawing required
Unique photoelectric-oscillating mirror principle
Permits digital output for tapes, cards, etc.

This new-approach instrument eliminates tedious re-tracing of flat charts with metallic inks, and makes possible swift reconversion to electrical output of any trace on continuous roll charts. Oscillating mirror-photocell design uses advanced optics to sweep, sense and convert any trace to electric energy. Model F-2 is also a complete Strip-Chart Recorder, offering features of Model 80 above.



NEW MODEL 42 DIGITAL TRANSLATOR

Permits cartesian plotting of digital data
Accepts keyboard, card, perforated or magnetic tape inputs
High-speed transistorized control circuits
Accepts 4 digits and sign per axis; front panel matrix contents display

Model 42 accepts digital data, presents analog output plus control signals for automatic operation of Moseley X-Y Recorders. Accuracy of analog-digital conversion 0.1%. Compatible with IBM Summary Punches and Card Readers including Models 514, 519, 523, 524, 526, etc. May be driven, without modification, by mechanical punched tape readers or motorized readers; also has 10-key serial keyboard for manual operation.

Accessories include Flexowriter converter, remote decimal contents readout panel, converter for optical or magnetic tape operation.

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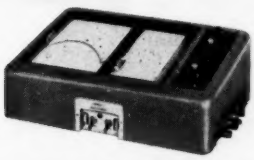
X-Y RECORDERS, STRIP CHART RECORDER, ACCESSORIES

Model 6S, AUTOMATIC CHART ADVANCE AUTOGRAF

A rack mounting X-Y Recorder with a capacity of 120 complete 10" x 10" charts in a standard roll. Internal transport mechanism automatically and precisely positions new chart when desired. Used charts may be stored or torn off individually. Vacuum paper hold-down; sweep circuit operates on Y-axis.

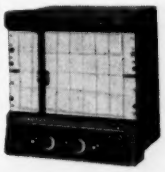
Model 2A and 2S AUTOGRAF

A flat-bed 11" x 17" X-Y Recorder for bench top use. Input facilities for point plotter, curve follower, tape or card translator. Internal vacuum system for paper hold-down. "T" square type recording mechanism with easily changeable ink pen. Model 2S includes sweep circuit on X-axis.



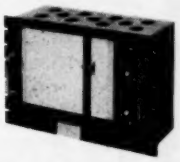
Model 3S AUTOGRAF

A flat-bed 8½" x 11" X-Y Recorder for tabletop use. Compact and lightweight, this instrument is ideal for general laboratory work. Independent servos drive "drafting machine" type pen mechanism without interaction. Model 3S includes sweep circuit on X-axis.



Model 4S and 4B AUTOGRAF

The model 4S is a rack mounting 11" x 17" X-Y Recorder with built-in facilities for data reduction and Curve Follower accessories. Model 4B is a two-pen X-Y Recorder for simultaneous plotting of two dependent variables. Each pen traverses full vertical scale. Both models include X-axis time base.



Model 5S and MR5 AUTOGRAF

A rack mounting version of the Model 3 AUTOGRAF, this 8½" x 11" X-Y Recorder occupies only 12¼ inches of vertical rack space making it desirable for use where a number of recorders are employed simultaneously. Model 5S includes a sweep circuit on the X-axis. Model MR5 is a militarized 400 cycle version of the Model 5, available on special order.

Model 1 AUTOGRAF

This completely portable 8½" x 11" X-Y Recorder is a preferred model for many uses. Drum type recording platen is compact and rugged. May be fitted with external Curve Follower. Removable cover protects operating mechanisms when transported.

Model 20 DC VOLTMETER

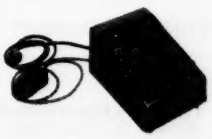
A high accuracy servo-actuated, multirange DC Voltmeter with large, easy to read, linear scale. Eleven voltage ranges: 3, 10, 30, 100, 300 millivolts and 1, 3, 10, 30, 100, 300 volts, full scale. Internal standard calibration cell. Input resistance 200,000 ohms/volt on all scales up to 30 volts; 60,000 ohms/volt on 100 volt scale; 20,000 ohms/volt on 300 volt scale. Zero left and zero center adjustment feature. 0.25% of full scale accuracy, all ranges.

Model 60B LOGARITHMIC CONVERTER

Converts DC or AC input voltages to DC voltages proportional to the logarithm of the positive peak amplitude of the input voltage. For use as a computer element or in gain-frequency plotting systems for recording characteristic curves of amplifiers or resonant devices. Better than 60 db dynamic range; 20 to 20,000 cps frequency range; normal operating speed 20 db per second; output ranges of 5, 10, and 20 db per inch; ± ½ db accuracy.

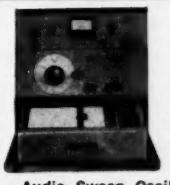
TYPE A-1 AC TO DC CONVERTER

An external unit to convert AC input voltages to DC voltages suitable for application to the axes of an Autograf X-Y Recorder. 20 cps to 100 KC frequency range; steps of 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10, 20 volts per inch, each axis; calibrated in RMS for sinusoidal input; 2 megohms input resistance (shunted by less than 25 mmfd); linearity 0.1% to 20 KC, 0.3% to 100 KC; accuracy 0.5% to 20 KC, 2% to 100 KC.



Model 40A KEYBOARD

Full keyboard type for direct use with Model 2 or 4 series AUTOGRAF. Built-in regulated power supply furnishes voltage to resistor matrices associated with keys for each axis. Plots from zero to ± 1999 on each axis; ± 0.10% digital to analog conversion accuracy; special circuits for calibration, error detection, and selection of "hold" or automatic "clear" on each axis independently. Available in ten-key type, Model 41A.



GAIN-FREQUENCY PLOTTING SYSTEM

Consists of Model 3 AUTOGRAF X-Y Recorder, Model 60B Logarithmic Converter, and Model 207 AR Hewlett-Packard motor driven Audio Sweep Oscillator, all conveniently mounted for bench top use. Characteristic curves are produced automatically as rapidly and as often as desired by merely pushing an actuating button. Better than 60 db dynamic range with ± ½ db accuracy. 20 to 20,000 cps frequency range. Flexible inter-connecting method makes individual units available for separate use.

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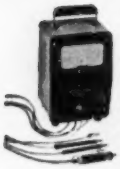


TYPE 810-A VTVM — Balanced circuits and liberal inverse feedback to insure long-time stability and accuracy. 7 full scale DC ranges: 1-1000 volts; 6 AC ranges; 1-300 V (rms); 7 resistance ranges 0.2 to 500 with multipliers of x1-x1 meg. DC accuracy ±2%; AC accuracy ±3%. Frequency response ±1 db, 10 cps to 700 mc. 100 meg input impedance for DC measurement. High input impedance to 700 mc maintained by 1.2 mmf input capacitance of AC probe.

TYPE 815-A VTVM — Has wide ranges. 9 full scale DC ranges; 0.1-1,000 volts; 8 AC ranges: 0.1-300 volts (rms); 9 DC current ranges: 0.001 ua to 100 ma; 9 resistance ranges: 0.2 to 500 with multipliers x0.1 to x10 meg. DC accuracy ±2%, AC ±3%, both 1 V range and higher. Frequency response 15 cps to 100 MC. DC input impedance 100 meg; AC 5 mmf and 10 meg. Also available as 815-AR (rack mount — gray panel).

IMPEDANCE MEASUREMENT

TYPE 310-B Z-ANGLE® METER — Measures in polar form the impedance, phase angle, dissipation factor, and storage coefficient of any RLC combination. One balancing control permits accurate analyses to be made more quickly and easily than with conventional AC bridges. Measures impedances from 0.5 to 100 k. Frequency range: 30 cps to 40 kc. Accuracy of impedance magnitude is ±1% to 20 kc and ±2 degrees for phase angle. Unit has internal 400 cps and 60 cps signals.

TYPE 314-A LOW-IMPEDANCE Z-ANGLE® METER — Measures low values of complex impedances in polar form. Direct readings of impedance in ohms, phase angle in degrees, and dissipation factor. Freq. range of 30-1000 cps, impedance-magnitude range of 0.005-1000 ohms accurate to ±1%, and dissipation-factor range of 0 to infinity. Phase angles measured from −90° to 0° to +90°, with accuracy of ±1°. 4-terminal arrangement nullifies effect of lead impedance and insures accurate measurements. Also available as 314-AR (rack mount).

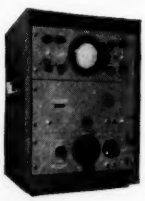
PHASE MEASUREMENT AND GENERATION

TYPE 320-AB PHASE METER — Measures phase difference between 2 signals (1 cps to 100 kc) of any wave shape and indicates phase angle on large meter with separate ranges of 360°, 180°, 90°, and 36°. Accuracy is ±(1% of full scale + 3 degrees). Requires no adjustments, corrections, or balancing operations. Amplitude range is .7 to 120 volts rms. Input impedance of 10 meg and 13 mmf. Also available as 320-ABR (rack mount).

TYPE 709-A BROADBAND SECONDARY PHASE STANDARD — Calibrates phase measuring instruments and measures phase when used with oscilloscope. Develops 2 sinusoidal signals variable from 0° to 360° with respect to each other. Range is 20 cps to 20 kc. Accuracy of ±1° from 20 cps to 10 kc. High input impedance, low output impedance. Inherent distortion less than 1%. 0.5 to 5-volt output varies less than ±2% with phase shift. Also available as 709-AR (rack mount).

TYPE 328-A TRANSISTORIZED PHASE METER — Frequency range 10 cps to 50 kc. Direct reading from 0 to 360° in 6 ranges of 60° each on large 5" meter scale. Absolute accuracy of 1° from 10 cps to 10 kc. Amplitude range .25 to 170 volts peak except at low frequencies. Input impedance: one megohm shunted by 20 mmf. Internal output impedance is approx. 100,000 ohms. Recorder connector provided. Power: 105-125 volts, 60 cycle AC, 20 watts. Terminals provided for operating from an external 45 volt battery, 50 mil drain. Also available as 328-AR (rack mount).

TYPE 7000-B AUDIO PRIMARY PHASE STANDARD — Calibrates phase detectors and phase shifting devices but can also be used to measure phase shift. Supplies 2 sinusoidal signals of same frequency whose phase relationship is continuously variable from 0° to 360° with ±0.05° accuracy, set by Lissajous pattern. Any single frequency available from 30 cps to 20 kc. Output of 1 to 10 volts rms from impedance of approximately 200 ohms.



TYPE 706-A ULTRA-SONIC PRIMARY PHASE STANDARD — Calibrates high frequency phase meters, phase detectors, and phase-shifting devices. Generates 2 sine-wave signals having variable phase difference 0° to 360° at any specified single frequency 20 to 200 kc. Phase angle accuracy of ±0.1 degree set by observation of multiple frequency Lissajous pattern on built-in scope. Also available as 706-AR.

TYPE 511-A POWER AMPLIFIER — Low distortion, low noise and phase shift compensated amplifier for 50 cps to 50 kc range. Output load characteristics: 5 ohms 12.8 watts, 25 ohms 13 watts, 200 ohms 15 watts, 1200 ohms 12 watts, down 1 db at 50 kc. Phase compensation permits application as drive source for Type 7000-B. Also available as 511-AR (rack mount).

TRANSMISSION AND DELAY MEASURING SETS

Measures the absolute amplitude and relative delay characteristics of 600 ohm transmission circuits in the frequency range from 200 cycles to 24 kc. The instrument consists of two basic units: the 451-A Transmitter and the 452-A Receiver.

The instruments will operate 32°F to 130°F and with normal 60 cycle line voltages ranging from 105 to 125 volts. It has an overall precision and accuracy of ±50 microseconds and a drift rate not exceeding ±50 microseconds per 30 minutes.

POTENTIOMETER TESTING EQUIPMENT

TYPE 394-A PONOGOMETER® STANDARD — Measures equivalent noise resistance (ENR) of single or multiturn precision potentiometers. Provides for establishing threshold level of ENR from 10-2000 ohms. ENR's above threshold level established produce both visual and audio indication. 100 kc frequency response flat to 50 kc. Accuracy is ±(3% of threshold value + 3 ohms). Recovery time is 1.5 seconds maximum. Also available as 394-AR (rack mount). Ideal for incoming inspection or laboratory analysis.

TYPE 395-C PONOGOMETER® STANDARD — Calibrates Ponogometer®. Accuracy 1%. Also available as 395-CR (rack mount).

TYPE 396-B PONOGOMETER® ATTENUATOR — Extends range of threshold resistance of Ponogometer®. Permits direct measurement of ENR's from 10 ohms to 100 k. Frequency response is ±3 db from 12 cps to 1.5 mc. Available as 396-BR (rack mount).

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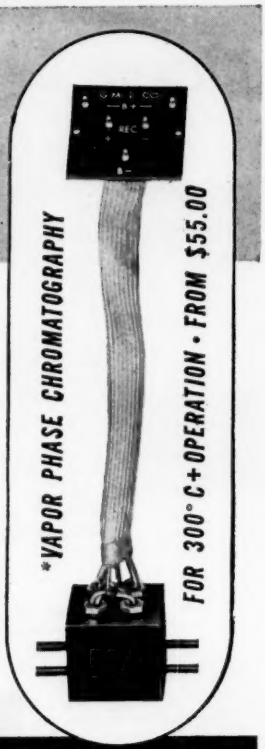

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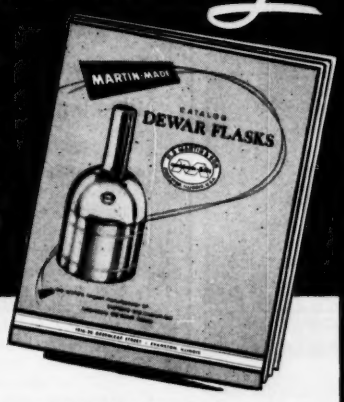

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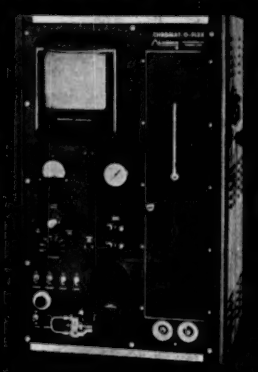

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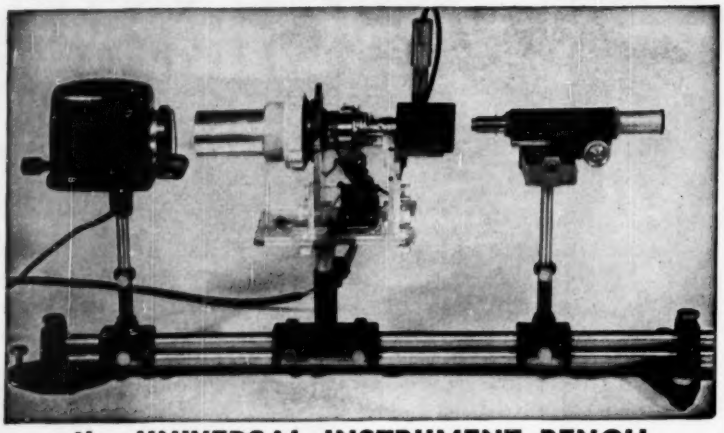

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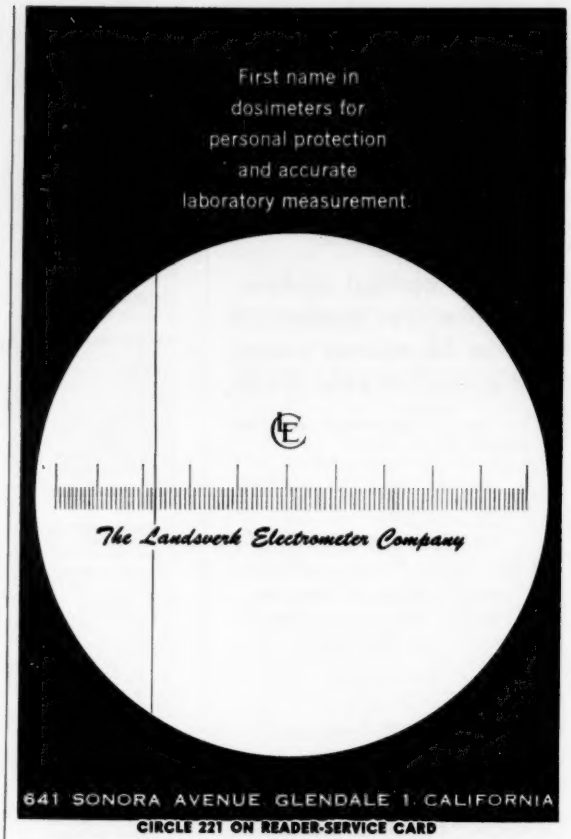

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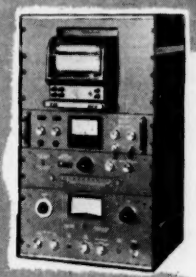

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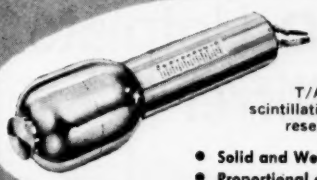

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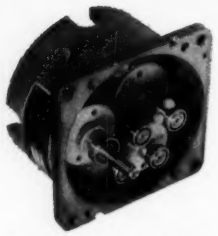

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Muirhead Instrs Inc
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Reeves Instr Corp
Schaevitz Engineering
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Sterling Precision
Tapco Group
U S Gear Corp
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Datran Electronics
Electrical Eye Equip
Electro Autosizing
General Controls
Genesys Corp
Gerber Scientific Inst
Gyrex Corp
Hydel Inc
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Kearfott Co
Librascope Inc
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Maxson Corp W L
Moseley Co F L
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Teller Co
Warner & Swasey Co

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Beckman/Helipot Div
Clifton Precision
Dalmotor Div
Daystrom Transicoil
Diehl Mfg Co
Dynamic Instr Corp
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Electro-Autosizing
Genisco Inc
Haydon Co A W
Induction Motors Corp
Induction Motors of Calif
Kearfott Co
Luther Mfg Co
Muirhead Instrs Inc
Sangamo Electric Co
Servo Systems Co
Teller Co
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Barber-Colman
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GPE Controls
Hydraulic Controls Co
Induction Motors of Calif
Kearfott Co
Mason Neilan
Midwestern Instrs
M-H Aeronautical Div
Muirhead Instrs Inc
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Palos Optical Co
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Unitron Instrument

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Bushnell & Co D P
Coast Instrument
E & W Optical
Edmund Scientific
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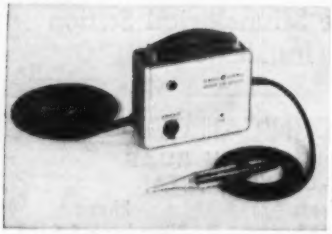
locates leaks in a flash . . .



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INSTRUMENT DEPARTMENT

GENERAL ELECTRIC

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Test Equipment

1960 BUYERS' GUIDE

6

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Hallikainen Instrs
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Geotechnical Corp
Hirschmann Co Carl
Magnaflux Corp
MB Electronics

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Kistler Instrument

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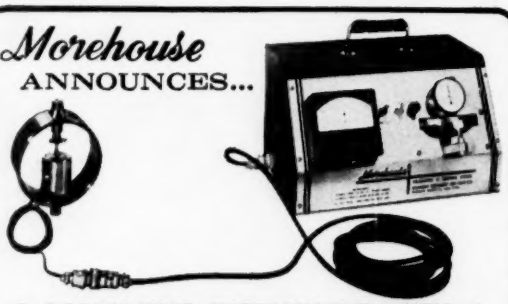

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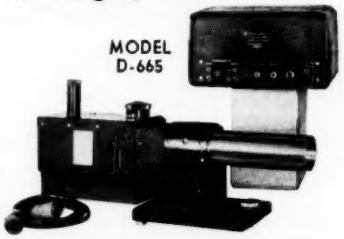

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Decker Corp
Dice Co J W
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Engis Equipment
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Metrol Inc
Nuclear Elx Corp
Photobell Co
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Ramsey Engrg Co
Sanborn Company
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Taft-Peirce Mfg
Warner & Swasey Co
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Dyna-Empire Inc
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Engis Equipment
Exactel Instrument
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Pratt & Whitney
Scherr Co George
Sheffield Corp
Size Control Co
Slocomb Co J T
Standard Gage Co
Starrett Co L S
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Engis Equipment
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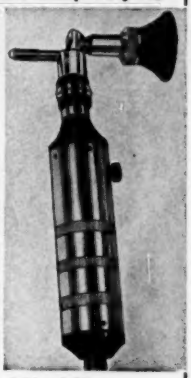

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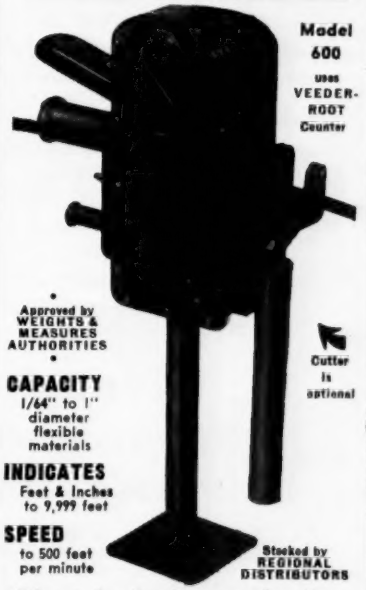

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Cutter is optional

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1/64" to 1" diameter flexible materials

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to 500 feet per minute

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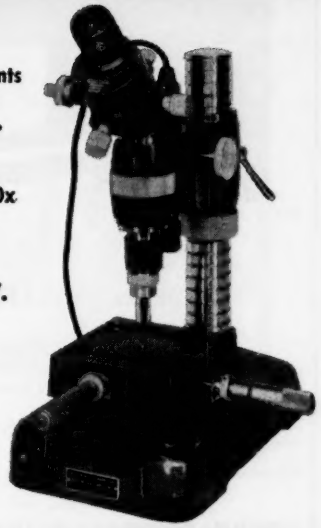

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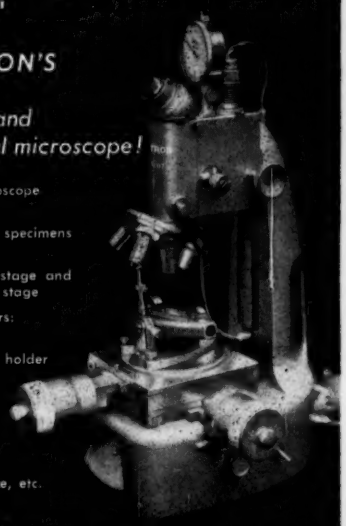

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- Inclinable work and tool holder
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Gaertner Scientific
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American Optical Co
Bausch & Lomb
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Richardson Camera Co
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Buhl Optical Co
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Epic Inc
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Lahline Inc
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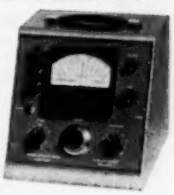
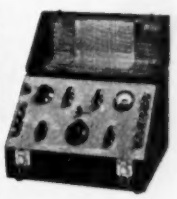
Strain Gage Instrumentation

BAM-1 Bridge Amplifier and Meter



Very convenient general purpose box. Static readings on meter. Dynamic readings on dc 'scope. Transistor dc amplifier with excellent low noise and drift. **Bulletin #6.**

BA-12 Bridge Amplifier



Accurate monitoring of fatigue tests. "Dynamic Null Balance" gives accuracy within 1% on steady dynamic signals. Used with any cathode-ray oscilloscope. **Bulletin #5.**

B-1 Bridge

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BSG-6 Switch and Balance, Bulletin #14.

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Penn Optical & Instr
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Bendix Utica Div
Carlson Co
Crosby-Ashton
Hirschmann Co Carl
Jan Hardware Mfg
Karr Co R J
Riehle Testing
Triner Scale & Mfg

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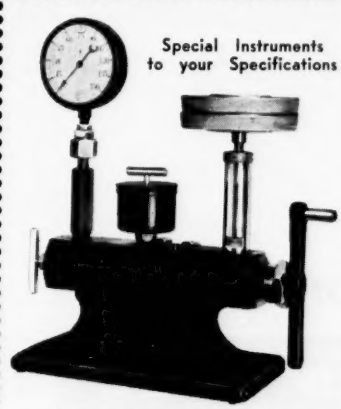

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GE X-Ray Dept
Nuclear Elx Corp
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Sheffield Corp
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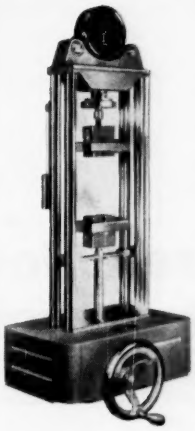

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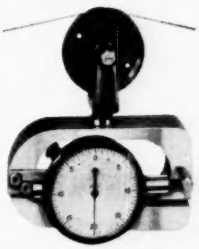

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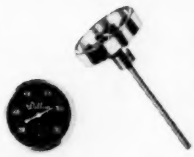

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7 General Instrumentation

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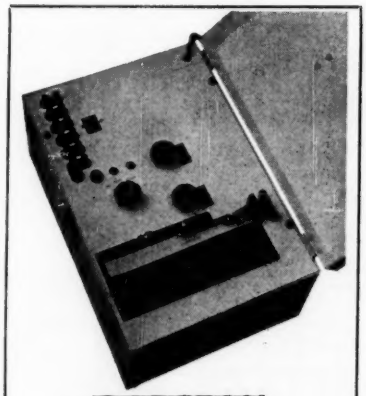

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Instr Development Co
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Philco Corp
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Southwestern Indus Elx
Spectra Electronics
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MILEAGE INDICATORS, including Gas Mileage, Truck-time, Recorders, etc.
Engler Instr

NEEDLES, Dip
Buff & Buff Mfg
Garlynn Engrg Co
Gurley W & L E

PANTOGRAPHS
Kollmorgen Optical
Mico Instr Co

PHOTOCOPY EQUIPMENT (see also Xerography Equipment)
Copease Corp
Eastman Kodak
General Photo Prods
Gordon Enterprises
Haloid-Xerox
Specialties Inc
Thermo-Fax
Vought Company

PLANIMETERS, Automatic Flow Recording
American Meter Co
Librascope Inc
Royson Engrg Co

PLANIMETERS, Linear and/or Radial (see also Integrators)
Epic Inc
Librascope Inc
Los Angeles Scien Instr
Royson Engrg Co
Sanders Labs

PLANIMETERS, Square Root
American Meter Co
Los Angeles Scien Instr
Pacific Transducer Corp
Royson Engrg Co

PLUMB BOBS
Berger & Sons C L
Buff & Buff Mfg
Garlynn Engrg Co
Graf-Apsco Co
Gurley W & L E

PROJECTORS, Film Slides, Lantern Slide and Opaque Object
American Optical Co
Bausch & Lomb
Buhl Optical Co
Bushnell & Co D P
Dukane Corp
Eastman Kodak
Gordon Enterprises
Optics Mfg Corp
Palos Optical Co
Richardson Camera Co
Camera Equipt Co

PYRHELIOMETERS
Eppley Laboratory

RADIATION ALARMS
Beva Laboratory
Cooper Development
Curtiss Wright
Designs for Tomorrow
Eberline Instrument
Electronics International
Nuclear Elx Corp
Nuclear Measurements
Nucleonic Corp of Amer
Picker X-Ray Corp
Riggs Nucleonics
Westronics Inc

RADIOACTIVE ISOTOPES
Curtiss Wright
Instruments Inc
Isotopes Specialties
Nuclear-Chicago
Nuclear Corp of Amer
Nucleonics Corp of Amer
Picker X-Ray Corp
Radiation Application
US Radium Corp
Western Radiation Lab

RULES, including Aluminum, Brass, Stainless Steel, and Steel
Croname Inc
Dixon Inc William
Millers Falls Co
Photoplating Co
Renick Co L C
Starrett Co L S

RULES, Precision Standard
Alteneder & Sons
Gaertner Scientific
Gurley W & L E
Renick Co L C

SLIDERULES, Engineering Calculation
Berger & Sons C L
Graf-Apsco Co
Greiner Co Emil

STANDARDS, Mass
Gilmore Industries
Gurley W & L E
Morehouse Machine

STANDARDS, Pressure
Consol Electrodynamics
Dynametrics Corp
Fischer & Porter Co
Gilmore Industries
Gulton Industries
Hass Instrument
Hill & Co E Vernon
Karr Co R J
Norwood Controls
Wallace & Tiernan

STANDARDS, Temperature
Gilmore Industries
Hill & Co E Vernon
Leeds & Northrup
Pyrometer Instr Co
Radiation Electronics

STANDARDS, Time
Canadian Marconi
Delta-f Inc
Designers for Industry
Geotechnical Corp
Hewlett-Packard
Parsons Co Ralph M
Times Facsimile

STANDARDS, Volume
Gurley W & L E

STETHOSCOPES, Engineers
Detecto Scales
Exact Weight Scale
Gurley W & L E
Morehouse Machine
Ohaus Scale Corp
Sheffield Corp
Torsion Balance Co
Wright Machinery Co

SURVEYING INSTRUMENTS, including Aneroid Type
American Paulin
Berger & Sons C L
Buff & Buff Mfg
Cubic Corp
Engis Equipment
Garlynn Engrg Co
Gordon Enterprises
Graf-Apsco Co
Hastings-Raydist
Starrett Co L S
Wallace & Tiernan

SURVEYING INSTRUMENTS, Underground, for wells or bore holes (see also Geophysical Instruments—Cat. 7)
Berger & Sons C L
Garlynn Engrg Co
Nuclear Dev Lab
Sanders Labs
Southwestern Indus Elx

TRANSITS, Pocket
Ainsworth & Sons
Garlynn Engrg Co
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G & B PRECISION LEVELS

Sizes
⅜" to 2"

VIALS—Variations of Size, Sensitivity, Color, Graduations, Operating Temperatures, and Radium Treatment.

STANDARD CIRCULAR LEVELS

Part No.	Diameter	Height	Sensitivity
5	11/16 inch	5/16 inch	130 min.
7	3/4	5/16	130
6	7/8	3/8	45
10	1	7/16	45
12	1 1/4	7/16	45
14	1 7/16	33/64	20
16	1 3/4	5/8	10
18	2	11/16	10
20	2 1/4	11/16	10
24	2 3/4	11/16	10

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TROY, N. Y. U.S.A.

CIRCLE 248 ON READER-SERVICE CARD

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T-Squares
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Circular & Linear Engraving to order

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All our Planimeters can be supplied with Automatic Zero setting.

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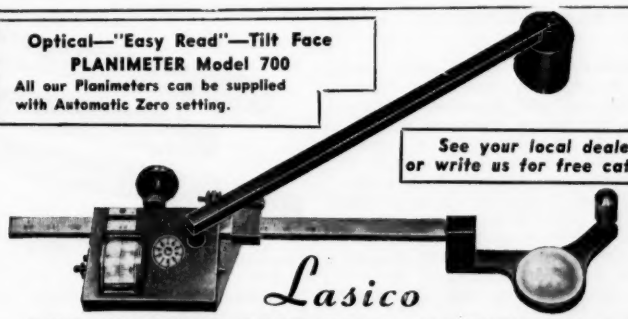

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2451 Riverside Drive Los Angeles 39, Calif.
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Dekoron® Products Division
SAMUEL MOORE & CO. • MANTUA, OHIO

Telephone Crestwood 4-2276

DEKORON MULTICOUPLE EXTENSION WIRE

Dekoron multiple pair harness of thermocouple extension wire is available in three constructions, each in either Iron-Constantan or Chrome-Alumel. Each is guaranteed to meet or exceed ISA specs for standard grade extension wire.

DEKORON ARMORED INSTRUMENT HARNESS

Four different tubing materials combined with four distinct types of armoring give 16 different types of Dekoron Armored Instrument Harness. Special Moore-Loc (modified square lock) galvanized steel armor has almost twice the pull-apart resistance of ordinary armor. Also has cord packing for extra resistance to moisture and fume penetration.

CONDENSED SPECIFICATIONS

COPPER TUBING

To ASTM B68 Type DHP specifications and pressure tested to ASTM B75 specifications.
¼ OD x .030″ in 50, 100, 500 and 1000′ lengths
⅜ OD x .032″ in 50, 100 and 500′ lengths
½ OD x .035″ in 50 and 100′ lengths

ALUMINUM TUBING

Drawn, seamless, annealed 5050-0 Utilitube. Sizes and lengths:
¼ OD x .032″ in 50, 100 and 500′ lengths
⅜ OD x .035″ in 50, 100 and 500′ lengths

POLYETHYLENE TUBING

High molecular weight, virgin polyethylene. Sizes and lengths:
¼ OD x .040″ in continuous lengths in increments of 100′ to 1000′
⅜ OD x .062″ in continuous lengths in increments of 100′ to 1000′
½ OD x .062″ in continuous lengths in increments of 100′ to 500′

PLASTIC SPECIFICATIONS

Polyethylene

Used as the sheath on single-line tubing, Metl-Cor and for black "P" Tubing, this polyethylene meets following specifications: ASA, REA, IPCEA requirements on weather resistance, chemical resistance, heat stability, and surpasses requirements under ASTM 1248-52T. Polyethylene, other than black, contains no ultraviolet inhibitor and should not be used outdoors. Black polyethylene is unaffected by ozone. This polyethylene remains flexible below —100°F.

Polyvinyl Chloride

Used as the sheath on Poly-Cor, "M" Ribbon, "P" Ribbon and single-line tubing, this polyvinyl chloride meets UL, ASTM, IPCEA, AN-C-168, AN-J-C-48A, J-C-129, and MIL-C-915 specifications.

Factory stocks of products described in this bulletin are made of materials that comply with specifications outlined above. Other materials and sizes, tube combinations, etc., are available on special order. Manufacturer reserves right to alter specifications without notice and incurring liability for products already shipped.

ACCESSORIES

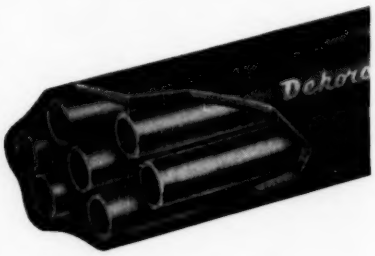
To facilitate installation of Dekoron products, we supply a line of tubing accessories which includes the following: junction and union boxes. E-Z fittings for plastic tubing, "P" Tubing clips, reel stands, harness straighteners, corner troughs and other aids for cutting installation costs.

INSTALLATION DATA

Complete data regarding bending radii, centers of support, hangers and clamp sizes and types, and various proven methods of installation are available on request.

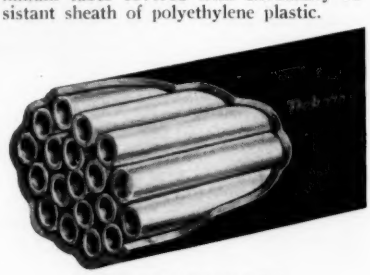
RESEARCH AND DEVELOPMENT SERVICE

Our Research and Development Department is constantly striving to design and develop new and improved products to enable instrument users to cut installed costs to the minimum and to achieve longer service-free life. The facilities of this department are available to you now to develop products and techniques to meet your specific requirements. Since our development program is continuous, we may already have solved your problem. Always check with the Dekoron Products Division first for the answers to your instrument tubing needs.



DEKORON METL-COR

Instrument line harness with tube combinations of 2 to 37 individual copper or aluminum tubes covered with chemically resistant sheath of polyethylene plastic.



DEKORON POLY-COR

Bundle of from 2 to 37 individual polyethylene tubes covered with vinyl plastic. Installs as easily as electric wiring.

DEKORON TUBING

The original plastic-coated metal instrument tubing. Available with copper, aluminum or steel core tube. Resists chemical attack, outlasts expensive alloy tubing.

DEKORON "P" TUBING

Highest quality single-line polyethylene instrument tubing. Easy to install; requires no special tools.

Dekoron is more than a name for chemically resistant instrument tubing. The Dekoron trademark now identifies a complete line of tubing products—instrument line harness, tubing, fittings, and accessories for tubing up a pneumatic system. Dekoron products cost less to buy . . . less to install . . . last longer. *So tube up with Dekoron products and watch your costs come tumbling down.*

REPRESENTATIVES

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George S. Edwards Co., Inc.
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Phone: YUkon 2-5405

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Phone: GLendale 5-4766

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Phone: GArden 6-2470

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Phone: REdwood 6-0749

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Phone: LExington 9-5558

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Detroit 12, Mich.
Phone: TWinbrook 1-6500

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St. Louis 17, Mo.
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Cleveland 5, Ohio
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E. Roy Myers Company
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Cincinnati 2, Ohio
Phone: DUnbar 1-7783

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Oregon

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Portland 22, Ore.
Phone: OLive 4-1745

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Biltmore Products Co., Inc.
1501 Potomac Ave.
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Phone: LOcust 3-0808

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Houston 25, Texas
Houston: JAckson 6-3027
Baton Rouge, La.: WAlnut 1-1618

STEPCO
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El Paso, Texas
Phone: PRospect 2-5274

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Tower Equipment Company
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Mercer Island, Wash.
Phone: ADams 2-1460 (Seattle)

Wisconsin

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Milwaukee 15, Wis.
Phone: MItchell 5-1711

Canada

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Toronto: CHerry 1-4401,
Montreal: VIctor 2-3015

Harvey Carruthers, Ltd.
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Vancouver 10, B.C.
Phone: TRinity 4-4202

Harvey Carruthers, Ltd.
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Calgary, Alberta
Phone: AMherst 3-7352

Components

8

1960 BUYERS' GUIDE

ELECTRICAL, ELECTRONIC, MECHANICAL, ELECTROMECHANICAL AND OPTICAL COMPONENTS

CRESCENT ARMORED MULTITUBE

—an armored group of 2 to 37 long length tubes of the user's choice, SPIRALLY CABLED together to permit maximum bending without distortion of the tubes. Mechanical and corrosion protection is accomplished by a flexible, interlocked, metallic armor or corrosion-resistant polyvinyl chloride sheath, or combination of both. There is a type of MULTITUBE to meet your requirements and give you the best protected instrument and control tubing installation at the lowest installed cost. We are able to provide your type promptly from large factory stocks of tubing.

TYPE CA
(General Purpose)

employs SPIRALLY CABLED copper tubes covered with a vinyl insulating tape and flexible, interlocked, galvanized steel armor.

TYPE CAT

has a vinyl insulating tape over the SPIRALLY CABLED copper tubes with a flexible, interlocked, galvanized steel armor and polyvinyl chloride (PVC) thermoplastic sheath. This construction provides mechanical and corrosion protection for the tubing as well as corrosion protection for the armor. For outdoor, wet and corrosive locations.

TYPE CTA

consists of SPIRALLY CABLED copper tubes with a polyvinyl chloride (PVC) thermoplastic sheath and flexible, interlocked, galvanized steel armor. The sheath protects the tubing against corrosion and the armor protects both tubing and sheath from mechanical injury. Recommended for general outdoor use and when a high degree of mechanical protection is desired for exposed locations or during installation such as direct burial in concrete or blacktop and pulling into conduit.

TYPE CTAT

provides maximum mechanical and corrosion protection. It has a polyvinyl chloride (PVC) thermoplastic sheath over the SPIRALLY CABLED copper tubes, with a flexible, interlocked, galvanized steel armor and polyvinyl chloride (PVC) thermoplastic sheath overall. For particularly corrosive locations as in refineries and petrochemical plants.

TYPE CT

The SPIRALLY CABLED copper tubes are protected by a polyvinyl chloride (PVC) thermoplastic sheath that is tough, resistant to water, acids, alkalies, oils and most chemicals and will not support combustion. Recommended for use in damp or corrosive locations, in troughs or attached to sheltered building surfaces where it will not be subjected to mechanical injury.

CRESCENT PLASTIC COATED SINGLE TUBE

For the individual connecting lines in a corrosion-protected system use CRESCENT PLASTIC COATED SINGLE TUBE. Copper or Aluminum tubing is protected from corrosion with the same tough, flame-retarding polyvinyl chloride (PVC) thermoplastic sheath as used on MULTITUBE.

CRESCENT POLYETHYLENE MULTITUBE

consists of 2 to 37 precision Polyethylene tubes *spirally cabled* together for greatest flexibility. The tubing assembly is protected against mechanical injury by an interlocked, galvanized steel armor, Polyvinyl Chloride sheath, or other sheaths, as below.

STANDARD TYPES

TYPE PA

TYPE PA—Interlocked metallic armor provides complete mechanical protection.

TYPE PAT

TYPE PAT—Polyvinyl chloride sheath over the armor adds corrosion protection for the armor. Can be buried in the earth.

TYPE PT

TYPE PT—PVC sheath gives limited mechanical protection. For use in troughs, trays or conduit.

SPECIAL SERVICE TYPES

TYPE XPT-U

TYPE XPT-U—Extra heavy PVC sheath over high modulus TYPE XP tubing permits direct burial, or use above ground where subject to moderate abuse.

TYPE XPT-F

TYPE XPT-F—Same as XPT-U with heavy asbestos braid and outer PVC sheath. Provides time delay in event of flash fire.

TYPE XPT-FA

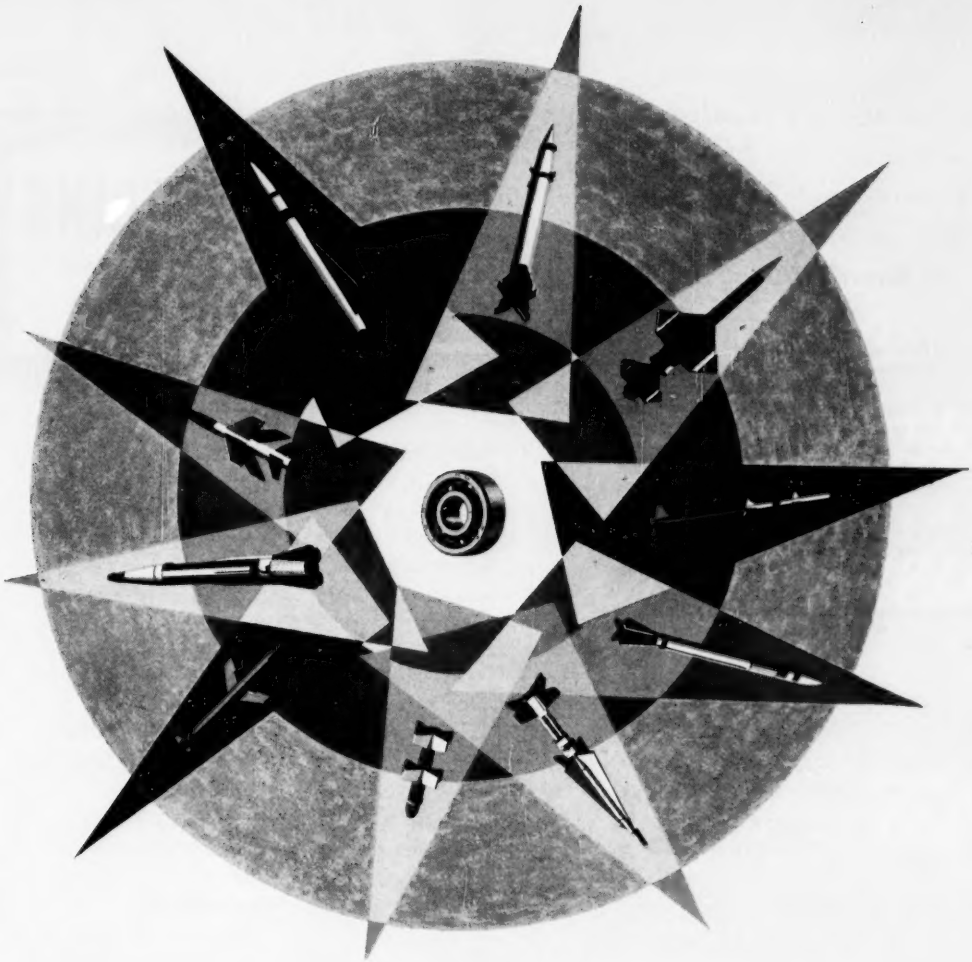
TYPE XPT-FA—Same as XPT-U with heavy asbestos braid and interlocked metallic armor. Provides complete mechanical protection, as well as time delay in event of flash fire.

WRITE FOR BULLETIN NO. 458-J

CRESCENT INSULATED WIRE & CABLE CO. INC.

TRENTON, NEW JERSEY

CIRCLE 251 ON READER-SERVICE CARD



THOR
MACE
TITAN
HAWK
ATLAS
NIKE B
BOMARC
NIKE ZEUS
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proved reliability you can build around

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GREATER PRODUCTION CAPACITY — GC Charts already are in use on more instruments than any other make. Now our integrated manufacturing facilities have been expanded broadly to serve you better.

FASTER, MORE EFFICIENT SERVICE — GC's centralized, electronic order processing and production control system expedites every order, insures prompt delivery — and can anticipate your future needs.

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MORE THAN 15,000 STOCK CHARTS TO CHOOSE FROM — there's a GC Stock Chart for almost every instrument and for every standard application.

SPECIAL CHARTS — And, for special requirements, GC Chart specialists can help you design the chart you need.

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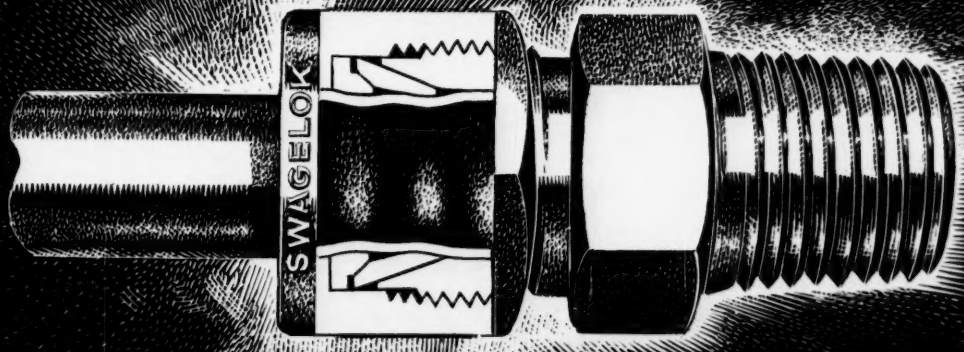
the Standard of Quality in Tube Fittings



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Don't go shootin' up the place just 'cause you went for those cheap component "buys" in your last program. Next time get yourself some reliable Borg components, install 'em and relax! Ok? Ok!

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- TRIMMING POTENTIOMETERS
- MULTI-TURN COUNTING DIALS
- FRACTIONAL H.P. MOTORS
- FREQUENCY STANDARDS

900 Series Micropots
Single, three and ten turn models. Independent, zero based or absolute reference linearity. Resistances to 300,000 ohms. Tested to 350° F.

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Ten turns. Independent or zero based linearity 0.1% to 0.05%. Resistance 25 to 100,000 ohms.

1100 Series Micropots
Ten turns. Independent linearity 0.5% to 0.1%. Resistance 25 to 100,000 ohms.

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990 and 991 Series Trimming Micropots. Wirewound and carbon element. Size 1¼" x 5/16" x 17/64". Resistance 10 ohms to 1 megohm — others on special order. Adjustment of complete range: wirewound — 40 turns; carbon element — 25 turns. Printed circuit, soldered lug, insulated wire lead terminals.

1300 Series Digital Microdials
Turn-counting dials. In-line digital presentation for fastest perception. Three-digit, ten-turn, four-digit hundred-turn and five-digit thousand-turn models. Also available — concentric scale models.

NEW 1360 Series Microdials
A new concept in dial appearance to further stylize panel designs. Retain superior mechanical features of Borg Concentric Scale Microdials.

Borg Fractional H.P. Motors
Synchronous or induction. Gear-trains. Two and four pole models. Ball-bearing type. Totally enclosed housings.

for your copy of Catalog BED-A90

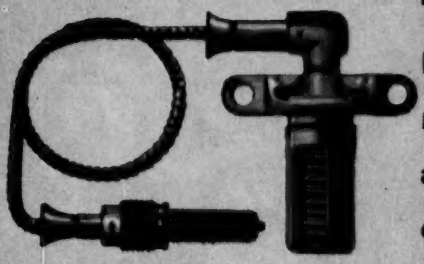
BORG EQUIPMENT DIVISION
AMPHENOL-BORG ELECTRONICS CORPORATION
JANESVILLE, WISCONSIN

CIRCLE 255 ON READER-SERVICE CARD

CIRCLE 256 ⟶

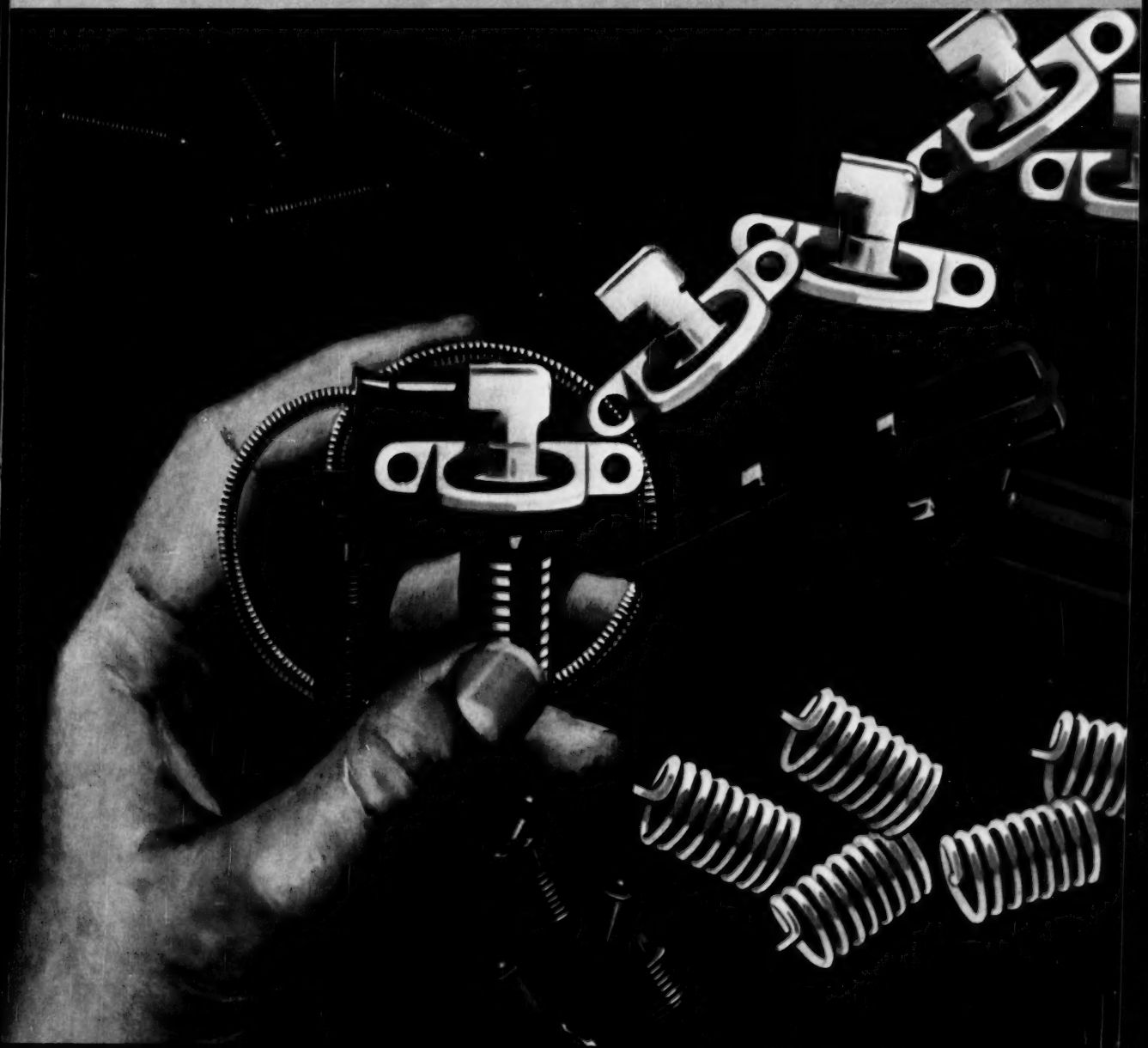
Robertshaw sets the pace with

PACKAGED BELLOWS

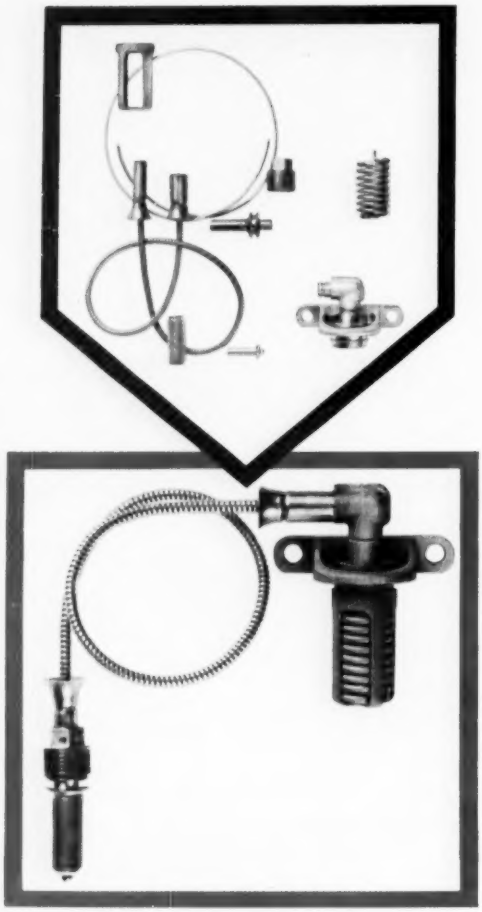


Don't lose orders...this single-source, cost-saving method can give you price and performance advantages your competitors can't match in equipment involving metallic bellows assemblies!

over



Robertshaw sets the pace with



PACKAGED BELLOWS

...from one source at one low cost!

In one custom-engineered, pre-assembled "package", you can now obtain hydraulically formed or welded metallic bellows and all assembly components from Robertshaw . . . at a definite saving. Packaged Bellows are designed, produced, assembled and tested right in our modern plant, and delivered to you ready for installation. You save on handling, assembling, inspections, testing and paper work.

No other bellows supplier can offer you such a wide range of bellows metals and alloys . . . including titanium, zirconium, Hastelloys, Inconel-X, Monels, stainless steels and all the standard bellows metals. Bellows sizes are available from miniature ¼" O.D. up. If your applications require it, Robertshaw can supply Packaged Bellows for operation in the range of 1000°F plus and above 3000 psia pressure. Proper selection of metals, plus precision manufacturing, can also give you the resistance to corrosion and vibration that your tough applications demand.

Write for Bellows Bulletin 10 giving typical application data!

New Robertshaw

FORMWELD BELLOWS

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Robertshaw

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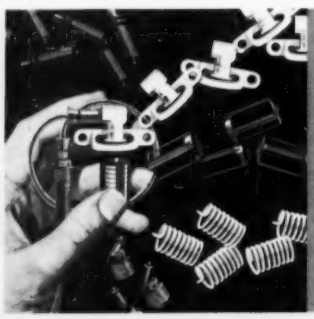

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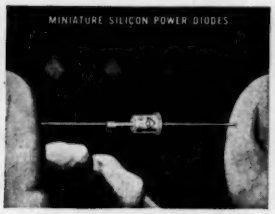

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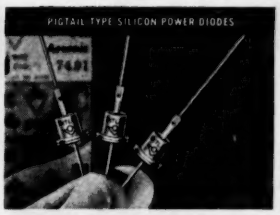

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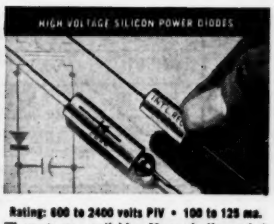

Rating: 600 to 2400 volts PIV • 100 to 125 ma.
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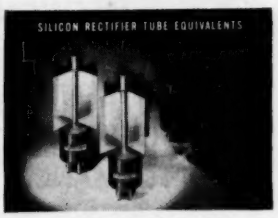

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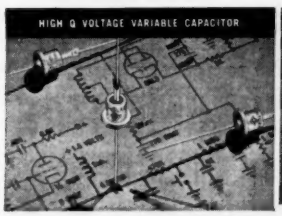

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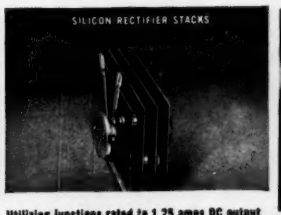

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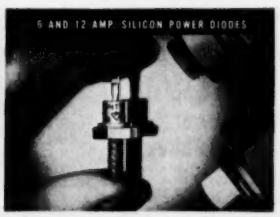

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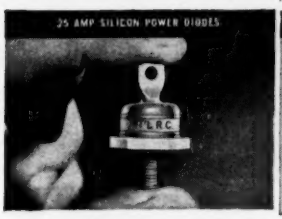

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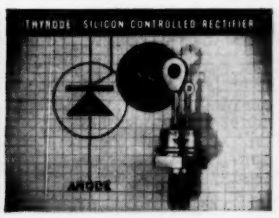

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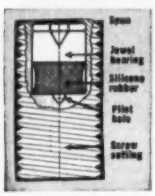

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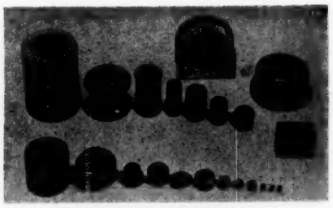

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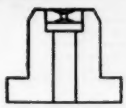

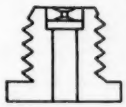

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Film Capacitors Inc
GE Apparatus Sales Div
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Gudeman Co
Interelectronics
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British Industries
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Leeds & Northrup
Mallory & Co P R
Marathon Electric
Muirhead Instrs Inc
San Fernando Electric
Sangamo Electric Co
Tobe Deutschmann Corp
Winslow Company Inc

CAPACITORS, Tantalum

Aerovox Corp
Baico Research Labs
Electronics Fabricators
GE Apparatus Sales Div
Gulton Industries
Sangamo Electric Co
U S Semiconductor Prods

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Baico Research Labs
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CAPACITORS, Variable

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Centralab Div
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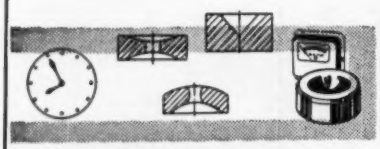

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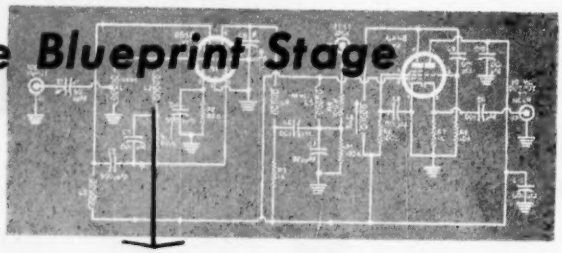

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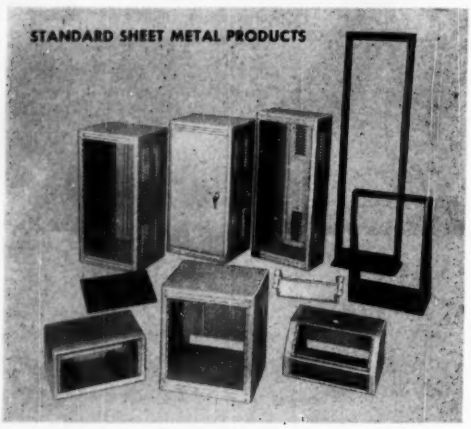

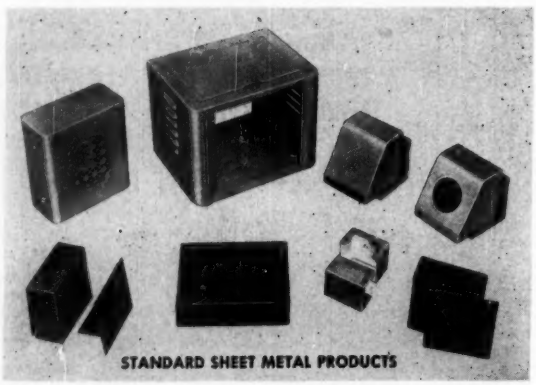

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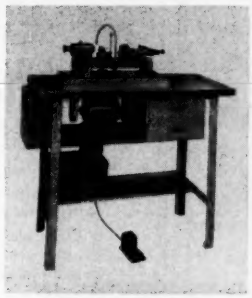

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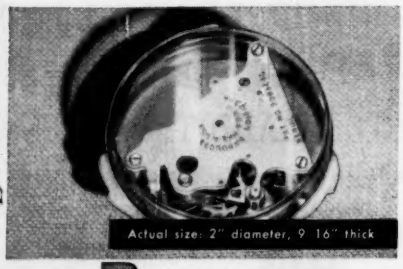

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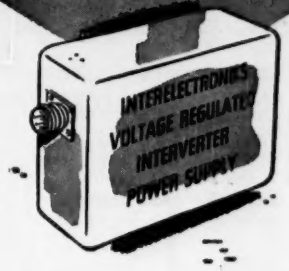

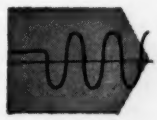

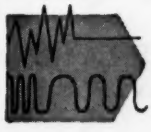

Interelectronics Interverter solid-state thyratron-like elements and magnetic components convert DC to any number of voltage regulated or controlled frequency AC or filtered DC outputs from 1 to 1800 watts. Light weight, compact, 90% or better conversion efficiency.

Ultra-reliable in operation, no moving parts, unharmed by shorting output or reversing input polarity. Complies with MIL specs for shock, acceleration, vibration, temperature, RF noise.

Now in use in major missiles, powering telemetering transmitters, radar beacons, electronic equipment. Single and polyphase AC output units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.

Interelectronics — first and most experienced in the DC input solid-state power supply field, produces its own solid-state gating elements, all magnetic components, has the most complete facilities and know-how—has designed and delivered more working KVA than any other firm!

For complete engineering data write Interelectronics today, or call LUdlow 4-6200 in N. Y.

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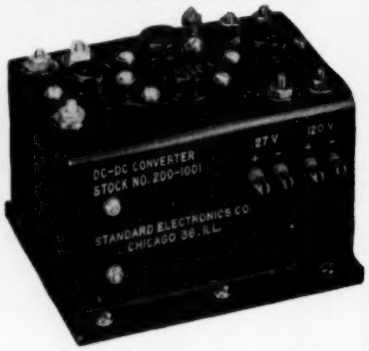
NEW THE "200" SERIES

DC to DC CONVERTERS

O.E.M. specifications

- Power ratings up to 500 watts
- Conversion efficiencies up to 85%
- Operates at temperatures up to 85° C.
- Regulation up to 1%
- Meets Military requirements for radio interference



Call or write today for complete engineering drawings and specifications.

STANDARD'S new transistorized DC to DC CONVERTER power source offers the optimum in reliable performance. Custom-designed to your individual requirements, the Series '200' is produced to STANDARD'S exacting quality controls. The unit is designed to meet Military Specifications.

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CONVERTERS, DC to DC Transistorized
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CONVERTERS, Electric-to-Hydraulic
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CONVERTERS, Rotary, DC to AC
Carter Motor
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Varo Mfg Co

CONVERTERS, Vibrator, DC to AC
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Lovejoy Flex Coupling
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CRYSTAL DIODES
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ALUMINA
ALUMINUM
ANTHRACENE
ARSENIC TRISULPHIDE
BARIUM TITANATE
BISMUTH
BRASS
CARBORUNDUM
CERAMIC
COBOLT FERRITE
COPPER
*CORNING 707
*CORNING 7052
CUPROUS BROMIDE
FERRITE
FERROX
**FLUORIDE, CALCIUM
**FLUORIDE, LITHIUM
GALLIUM ANTIMONIDE
GALLIUM ARSENIDE
GARNET
GERMANIUM
GOLD
INDIUM ANTIMONITE
INDIUM PHOSPHIDE
INDOX
IRON SINGLE CRYSTAL
LITHIUM FERRITE
MAGNETIC PLUMBITE
MELAMINE FIBER GLASS
MICA, SYNTHETIC
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*QUARTZ, FUSED
**SAPPHIRE
**SODIUM CHLORIDE
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*VYCOR
*X-RAY LEAD GLASS
ALL TYPES KNOWN GLASS

* Carried in stock
** Purchased for orders

CIRCLE 281 ON READER-SERVICE CARD

for your

SINGLE CRYSTAL REQUIREMENTS

single crystals we grow at present

Aluminum
Aluminum Oxide
Barium Fluoride
Barium Titanate
Barium Titanate (Iron Doped)
Calcium Fluoride
Cesium Bromide
Cesium Chloride
Cesium Iodide
Cesium Iodide Thallium (Activated)
Copper
Gadolinium Iron Garnets
Germanium
Lead
Lithium Bromide
Lithium Chloride
Lithium Fluoride
Magnesium Oxide
Magnesium Oxide (Iron Doped)
Magnesium Oxide (Copper Doped)
Magnesium Oxide (Chromium Doped)
Magnesium Oxide (Titanium Doped)
Potassium Bromide
Potassium Chloride
Potassium Fluoride
Potassium Iodide
Potassium Iodide (Thallium Activated)
Rubidium Bromide
Rubidium Chloride
Rubidium Iodide
Silicon
Silver Bromide
Silver Chloride
Sodium Bromide
Sodium Chloride
Sodium Iodide
Sodium Iodide (Thallium Activated)
Strontium Chloride
Thallium Bromide Iodide
Yttrium Iron Garnets
Zinc
Zinc Sulphide

ALSO CUSTOM CRYSTAL GROWING

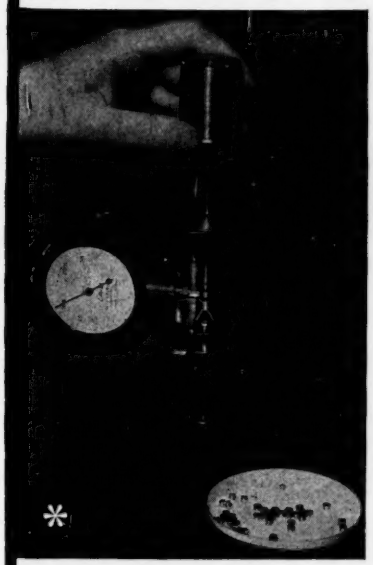
SINGLE CRYSTAL DIVISION

SEMI-ELEMENTS INC.

Saxonburg Blvd., Saxonburg Pa., USA

CIRCLE 282 ON READER-SERVICE CARD

There's a *Bird* JEWEL BEARING to fit Your Need!



Bird can supply you with sapphire and borrosilicate glass precision jewel bearings in a wide range of standard types, sizes, and complete assemblies — or, custom-built to your specifications. Special mounting techniques provide exact tolerance jewel assemblies, mounted or set in bushings or screws, ready for assembling into your product without further inspection. Jewels mounted with resilient silicone rubber or spring cushions provide additional protection to shock and vibration.

Because of the exact tolerances, maintained through the most rigid quality-control methods, Bird jewels are used by the foremost manufacturers of electrical, aircraft, and timing instruments — and recorders.

Typical products include:

Aircraft Instruments
Weather Recorders
Ammeters
Voltmeters
Wattmeters
Compasses
Dial Gages
Timers
Test & Recording Instruments
Marine Instruments

**Illustrated — Concentricity check of mounted ring jewels — one of the inspection processes in Bird's quality control program.*

Our engineering staff is at your service for all small bearing problems. A request on your letterhead for Bulletin 100-6 will receive our prompt attention.

Richard H. Bird & CO., INC.

1 SPRUCE ST., WALTHAM 54, MASS.

SAPPHIRE & GLASS JEWELS
PRECISION GLASS GRINDING
JEWEL MOUNTING & ASSEMBLY

CIRCLE 283 ON READER-SERVICE CARD

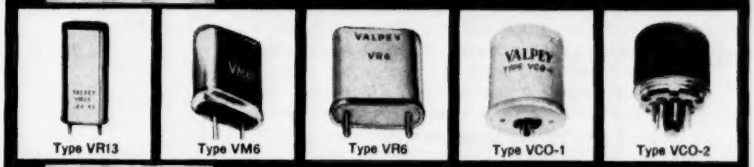
VALPEY

craftsmanship has produced frequency control, transducer and filter crystals to withstand the severe vibration and extended ambient temperatures encountered by today's missiles and ground equipment. Valpey, knowing what is expected in the design of such equipment, handles these problems realistically, utilizing the experience gained over the past 27 years. If you have a problem in frequency or temperature control which must be solved, contact

VALPEY . . . YOUR SOURCE FOR:

To insure performance to your specifications, Valpey has complete up-to-date test equipment, with access to the most stringent environmental test facilities.

- Oscillator crystals — in audio through VHF range for military and commercial requirements.
- Quartz and tourmaline transducers.
- Filter crystals.
- Crystal units and sub-miniature ovens designed for printed circuit applications.
- Temperature controlled ovens for crystals and small components.
- Specialty grinding and optical pieces in fused quartz, natural quartz and other hard materials.



Type VR13 Type VM6 Type VR6 Type VCO-1 Type VCO-2

CATALOGS ON REQUEST

Valpey Crystal Corporation, holliston, massachusetts

Craftsmanship IN CRYSTALS SINCE 1931

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Bulova Research
Demornay Bonardi
Diamond Antenna
Elco Corp
Microwave Associates
Nuclear-Chicago
Waldom Electronics

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Acoustica Assoc
Centralab Div
Gulton Industries
Semi-Elements Inc

CRYSTALS, Semiconductor

GE Semicond Prods
Gulton Industries
Hughes Products
Republic Lens Co
Semi-Elements Inc
Texas Instruments

CRYSTALS, Piezoelectric

Bliley Electric
Bulova Research
Centralab Div
GE Heavy Mil Elx Dept
Gulton Industries
McCoy Electronics
Piezo Crystal Co
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Valpey Crystal Corp

CRYSTALS, Quartz, Rochelle Salt

Andersen Labs
Bulova Research
Gulton Industries
Herron O. tical
Piezo Crystal Co
Republic Lens Co
Semi-Elements Inc
Valpey Crystal Corp

CRYSTALS, Rock Salt, Optical

Republic Lens Co
Semi-Elements Inc

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CRYSTALS for Watches, Gages, etc.

Applied Instruments Inc
Zenith Optical Lab

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Acme Industrial Co
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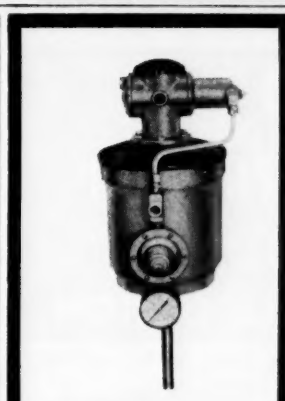
Bailey Meter Co
Conoflow



CONOFLOW CYLINDER ACTUATOR . . . . . shows you the way to AUTOMATION

Conoflow Series 50 Cylinder Conomotor Actuator affords automatic throttling control for many types of process regulating equipment previously limited to hand control. The Cylinder Conomotor is a powerful pneumatic servomechanism capable of following the exact signal outputs of modern electronic and pneumatic instruments.

It has found wide industrial application for automatic control of numerous types of valves, motor driven speed changers, proportioning pumps, flow regulators, and many electrical systems components such as rheostats, autotransformers and potentiometers.

Investigate the possibility of using the Cylinder Conomotor with your processing equipment. Write for Bulletins B-50-3 and EB-3, today.

OC716

CONOFLOW CORPORATION
SUBSIDIARY OF WALWORTH COMPANY
2100 ARCH STREET • PHILADELPHIA 3, PA.

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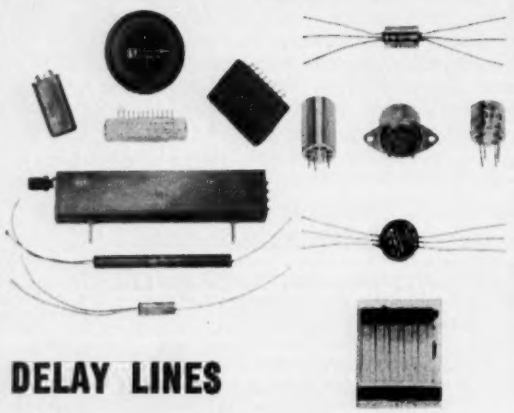

DELAY LINES
and PULSE TRANSFORMERS

Top quality, precision components of proven dependability, designed to withstand shock and vibration and to meet military environmental requirements. All Delay Lines and Pulse Transformers come in a variety of standard models or can be manufactured to specification.

PCA ELECTRONICS, INC.
16799 Schoenborn Street, Sepulveda, California
Leading Manufacturer of CUSTOM-DESIGNED Delay Lines and Pulse Transformers in the Electronic Industry.

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ALLEN AIR CORP.
(THE LARGEST MANUFACTURER OF CYLINDERS IN MINEOLA)
DOUBLES PRODUCTION

Using their own products helped a lot, but working 16 hours a day was the only answer.

AIR CYLINDERS
AIR VALVES
INDEXING TABLES
AIR CLAMPS

ASK FOR OUR NEW CATALOG
Write Before Next Tuesday!

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Bristol Co
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Ramo-Wooldridge
U S Gauge Div

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Amperex Electronic
British Industries
CBS Electronics
Clevite Transistor Prods
Erie Resistor
Green Rectifier
GE Semicond Prods
General Transistor
Hughes Products
Lansdale Tube
Ramo-Wooldridge
Semi-Elements Inc
Tech Apparatus Bldrs
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Amperex Electronic
British Industries
CBS Electronics
Clevite Transistor Prods
GE Semicond Prods
Green Rectifier
Hoffman Electronics
Hughes Products
International Rectifier
Lansdale Tube
Microwave Associates
Pacific Semiconductors
Ramo-Wooldridge
Semi-Elements Inc
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Silicon Transistor
Sylvania Semiconductor
Texas Instruments
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Transitron Electronic
U S Semiconductors Prods
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DRIVES, Variable Speed
Boston Gear Works
Bowmar Instrument
Cleveland Worm & Gear
Cutler-Hammer
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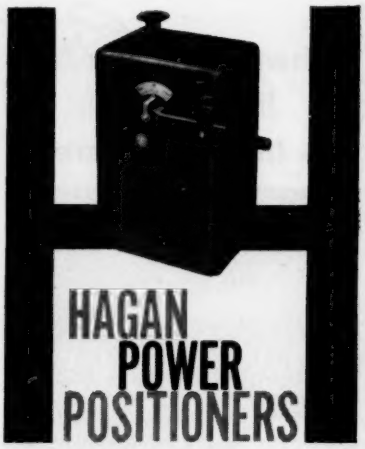

HAGAN POWER POSITIONERS

Accurate and completely reliable, the Hagan Power Positioner has plenty of power for the exact positioning of dampers, valves and other mechanisms.

Movement of piston is normally linear with signal pressure, but any desired relationship may be obtained by shaping the cam of the integral feedback mechanism. The Hagan Power Positioner is air operated, and uses full 80-120 psig power air.

HAGAN CHEMICALS & CONTROLS, INC.
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto
European Division: Via Fiumendosa No. 13, Milano, Italy

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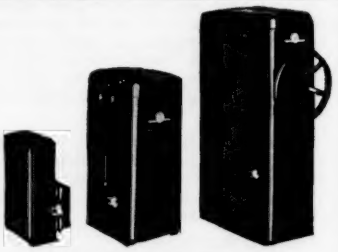


BAILEY
CONTROL DRIVES

● These air-operated power units provide precise positioning of regulating devices such as dampers, butterfly valves, hydraulic couplings and feeders in accordance with a pneumatic control signal.

Improves flow characteristics through simple adjustment of positioning relay incorporated in the drives.

Easy installation and choice of location made possible by angular rotation of power take-off plus full assortment of standardized connecting linkage.

Type	Torque (ft-lb)	Max Angular Travel
AC44P	75	75°
AC68P	400	90°
AC816P	1500	90°
AC1016P	2350	90°
Type	**Force (lb)**	**Linear Travel**
AC1030P	1600	30 in.
AC1260P	2500	60 in.

Request Product Specification P81-1 for Control Drives and Product Specification P81-5 for control linkage.

BAILEY METER COMPANY
1041 IVANHOE ROAD CLEVELAND, O.
Bailey Meter Company Ltd. Montreal Canada

CIRCLE 289 ON READER-SERVICE CARD

THE BIG LOOK

2½-inch size

ACTUAL SIZE—Although they look bigger, these a-c and d-c units are actually 2½- and 3½-inch sizes. Mounting is interchangeable with JAN, MIL and ASA (round) specifications. *Widest range of scales and face-plate colors are available.*

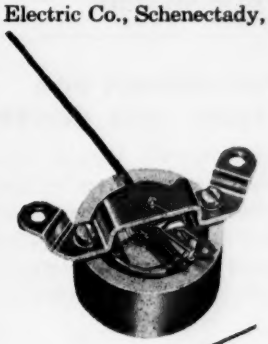
3½-inch size

General Electric small panel meters

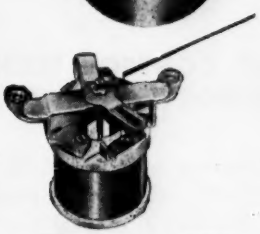
BIG LOOK styling of General Electric's new small panel meters adds *functional beauty* to your products and equipment. Distinctive design creates the illusion of bigness, yet these new meters fit into the same panel space as old style meters. You get big border-to-border scale . . . *modern, clean-line design . . . your choice of seven attractive colors* . . . and widest selection of scales.

Up to 28% longer scales allow accurate readings. Tough neoprene gaskets provide *complete protection* of internal parts and movements from dirt, dust or water. Best of all, General Electric BIG LOOK meters are *competitively priced.* And you can plan on *fast delivery,* too, from a national network of authorized stocking distributors and G-E Apparatus Sales Offices.

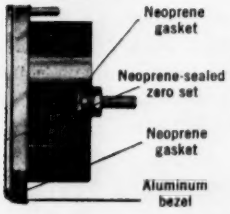
Let G.E.'s BIG LOOK in panel meters help you improve the appearance and reliability of your equipment at low cost. Get the full story. Just contact your G-E Apparatus Sales Engineer, or write for bulletin GEA-6678, Sect. 593-303, General Electric Co., Schenectady, N. Y.



SELF-SHIELDED CORE-MAGNET, used in d-c milliammeters below 5 MA and all microammeters, permits mounting of meters on magnetic or non-magnetic panels without special calibration.



ALL A-C METERS utilize moving-iron mechanisms—plus magnetic damping to settle the pointer quickly and accurately.



COMPLETELY SEALED CASES protect internal parts of instrument from harmful contaminants. Even zero-set is sealed with a neoprene O-ring.

Progress Is Our Most Important Product

GENERAL ELECTRIC

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SCHOTT

Narrow Band Interference Filters

Transmission up to 45% . . . Half-band width down to 5 mμ . . . Peak wave-length region: from 400 to 2,000 mμ . . . Size of filters: 2" x 2" . . . Regular quality IL: Tolerance at peak wave length ±1% . . . Precision quality PIL: Tolerance at peak wave length +0.5%.

Ask for Bulletin NBF-339

SCHOTT Monochromatic Interference Filters

for the 310 to 389 mμ Ultraviolet Spectral Region.

Ask for Bulletin 302UV

SCHOTT-JENA Raw Optical Glass

Made in West Germany

FS Multi-Layer Interference Films

Part of the spectrum is strongly reflected and the balance strongly transmitted, according to requirements. Absorption is negligible. Transmission or reflection peaks as high as 85 to 90% but the spectral bands are relatively broad.

Ask for Bulletin MI-318

FISH-SCHURMAN CORPORATION
68 Portman Road New Rochelle, N. Y.

Fish-Schurman

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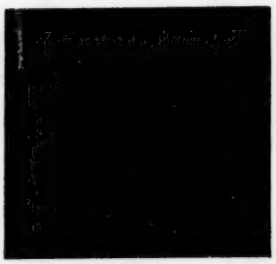

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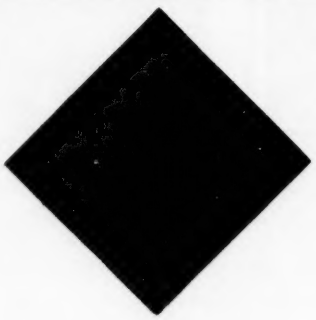

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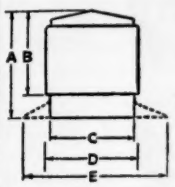

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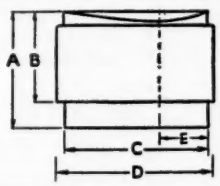

Series	A	B	C	D	E
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90	1.03	.80	1.23	1.38	.42

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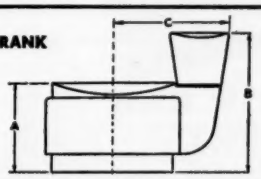

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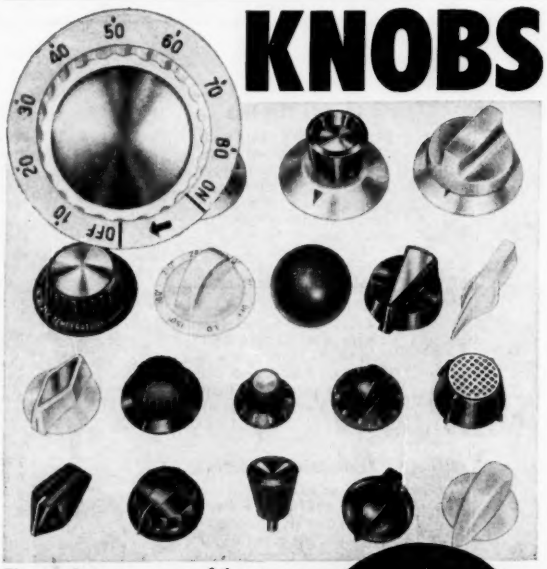

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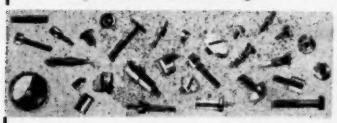

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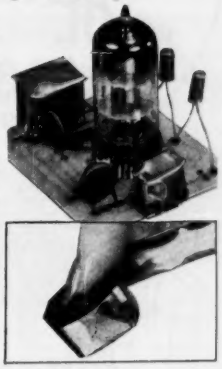

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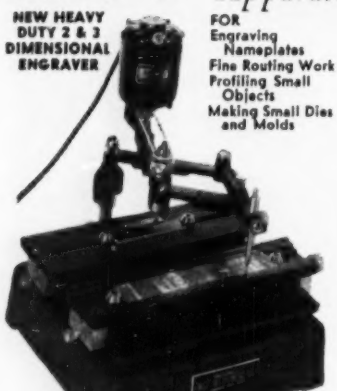

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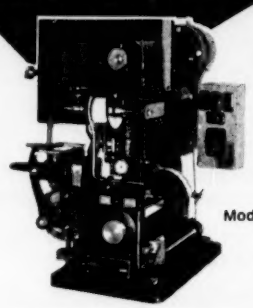

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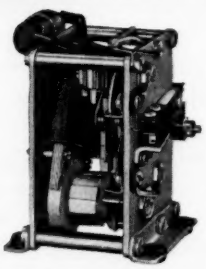

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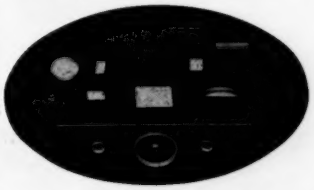

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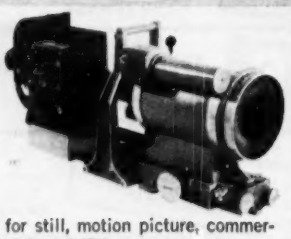

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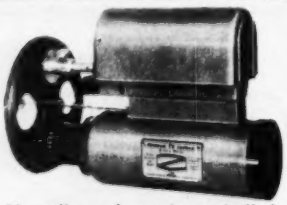

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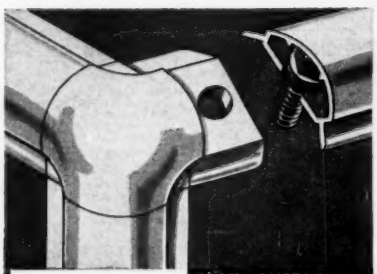

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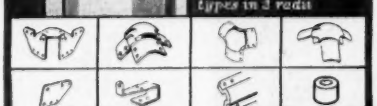

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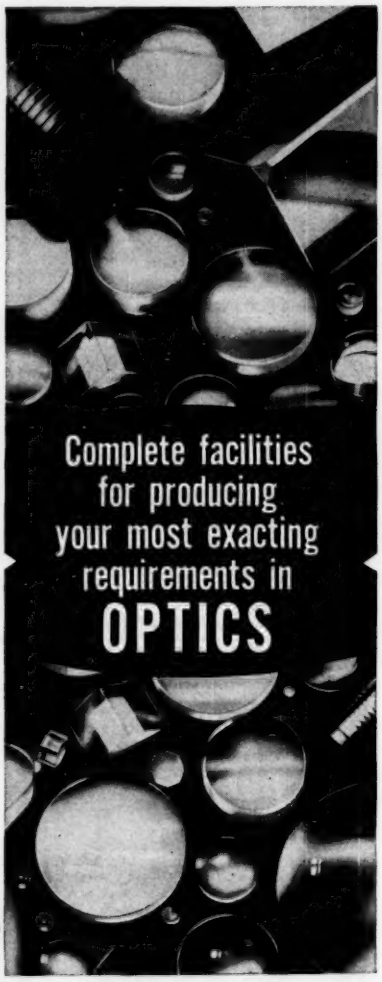

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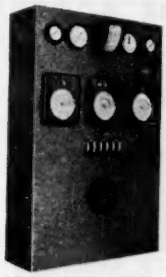

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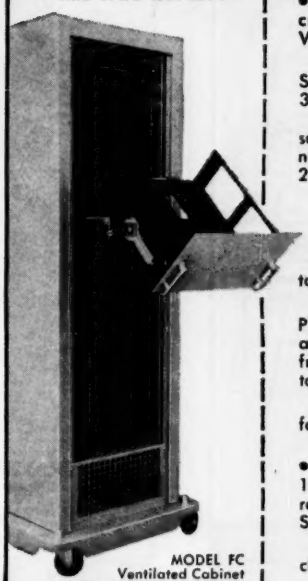

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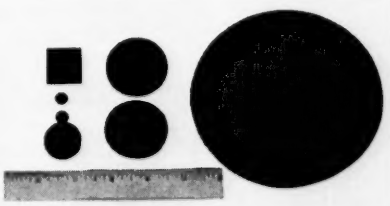

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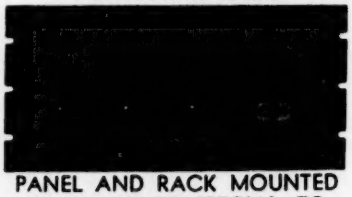

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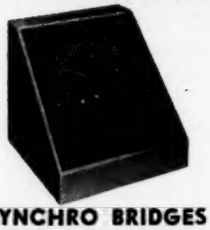

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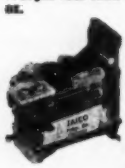

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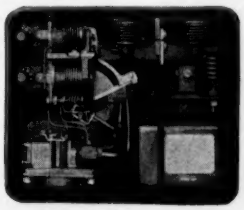

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COMPUTING RELAY

• Receives pneumatic signals from transmitters, controllers, and/or relays and produces a control signal according to the computing or control action desired.

As a computer it can multiply, divide, reverse, subtract, average, or totalize pneumatic signals.

As a controller it provides the following control actions: Proportional; Proportional **plus Reset**; Proportional plus Rate; Proportional plus Reset plus Rate; and Floating (Reset only).

Request Product Specification P99-3.

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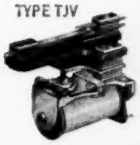

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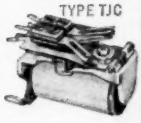

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TYPE Z

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Avoid excessive relay costs... reduce needless relay space requirements... simplify installation and get better performance with relays by Comar, custom-made to your specifications. All types are available with any combination of switches, contact materials, coils, leads and mountings required. Write for complete information today.

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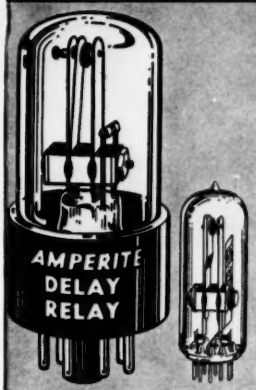
AMPERITE

THERMOSTATIC DELAY RELAYS



2 to 180 Seconds

Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.

Hermetically sealed. Not affected by altitude, moisture, or climate changes.

SPST only—normally open or closed.

Compensated for ambient temperature changes from —55° to +70° C. Heaters consume approximately 2 W. and may be operated continuously. The units are **rugged, explosion-proof, long-lived, and—inexpensive!**

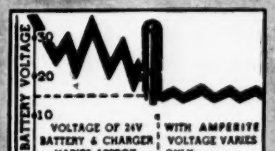
TYPES: Standard Radio Octal, and 9-Pin Miniature . . **List Price, $4.00.** Standard Delays

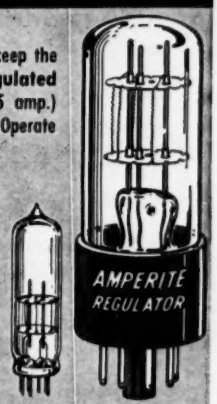
Also — Amperite Differential Relays: Used for automatic overload, under-voltage or under-current protection.

PROBLEM? Send for Bulletin No. TR-81

AMPERITE
BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit **automatically regulated** at a definite value (for example, 0.5 amp.) . . . For currents of 60 ma. to 5 amps. Operate on A.C., D.C., or Pulsating Current.





Hermetically sealed, they are not affected by changes in altitude, ambient temperature (—55° to +90° C.), or humidity . . . Rugged, light, compact, most inexpensive . . . . . **List Price, $3.00.**

Write for 4-page Technical Bulletin No. AB-51

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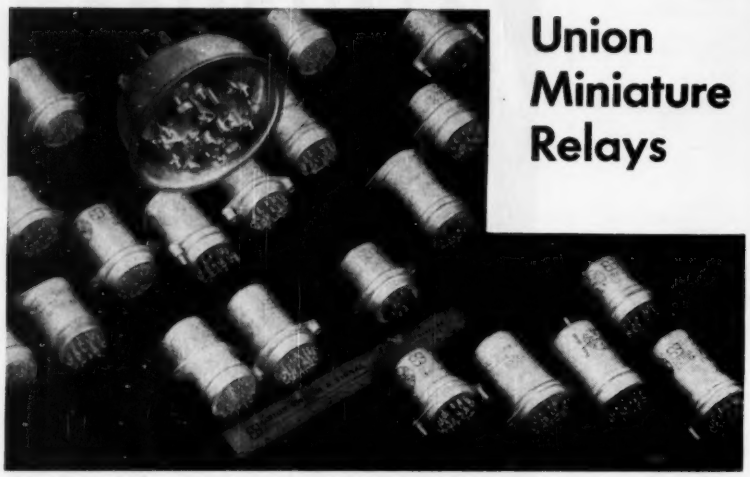
Tops in reliability!



Union Miniature Relays

Used in seven successful missiles. Union Miniature Relays originally were developed for air-borne and guided missile electronic equipment; they meet or exceed the requirements of MIL-R-25018, MIL-R-6106C, and MIL-R-5757C. They are now being utilized in the following missiles: The Matador, Thor, Talos, Vanguard, Atlas, Titan, and the Jupiter C.

The excellent reliability and small size of the Union Miniature Relays have led to their use in traffic control systems, computers, resistance welders, and other equipment.

OUTSTANDING FEATURES

HI-LO CONTACTS—Permit high and low load handling in same relay. Dry-circuit contacts available for extremely low-level loads.

COIL RESISTANCE—In standard case, from 0.9 to 8750 ohms; in long case, from 1.6 to 13,000 ohms.

TEMPERATURE RATING—Class A −55 to +85°C; Class B −65 to +125°C.

AC OR DC—Nominal operating voltages from 1.5 to 160 volts, DC; 115 volts, 60 to 400 cps, AC. Built-in rectifiers in AC relays.

TYPES AND MOUNTINGS—6PDT or 4PDT; plug-in or solder-lug connections. All usual mountings.

SPECIALS—Slow-acting relays if you need a differential between operating time of various relays. Plate-circuit relays—operate on less than 8 milliamperes; double-coil relays—either coil operates relay. Write for complete information.

"Pioneers in Push-Button Science"

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
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Federal Pacific
Weston Instruments

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A clear and thorough treatment of the practical aspects of automation—the application of the instrument to the process. Covers: plant controllability; measuring and transfer lags; controller operation; valve characteristics; and disturbance effects. Include many examples. 380 pages + XVIII, cloth 5¾" x 8¾"

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Thousands of Different Types—Most Makes
PRODUCTION QUANTITIES IN STOCK

STEPPING SWITCHES

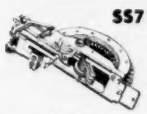
WESTERN ELECTRIC

5 Level 22 Position
Gold Plated Wipers

SS6

Mfd. by Western Electric; 22 step; 5 levels; Bridging wipers; Contacts: Gold plated brass. Interrupter Switch: 1 Break-Make; Net Weight: 2 lb 2 oz. "Homing" type; 180° wipers; Step in one direction. Single coil.

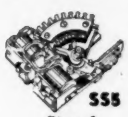
	ea
#R926; 6 to 12 VDC	13.75*
#R980; 24 to 36 VDC	14.75*
#R981; 48 to 60 VDC	15.75*
#R615; 100 to 125 VDC	16.75*



SS7

Mfd. by Western Electric; 44 step; 2 circuits; Bridging Wipers; Contacts: Gold plated brass; Interrupter switch: 1 break-make; Net weight: 1 lb 14 oz; "Homing" type; 360° wipers; Single coil; Step in one direction.

	ea
#R927; 6 to 12 VDC	13.75*
#R982; 24 to 36 VDC	14.75*
#R983; 48 to 60 VDC	15.75*
#R616; 100 to 125 VDC	16.75*



SS8

Step & Reset

Minor Switch 10 steps and off. Contacts: Nos. R960 975, 976 Gold plated brass; Bridging wiper; Others—beryllium-copper, Nonbridging wiper; 2 coils, step and reset; Net Wt: 1 lb.

Volts DC	1 level Stk#	1 level Price*	3 level Stk#	3 level Price*
6- 12	R960	9.50	R642	11.50
24- 36	R975	10.50	R600	12.50
48- 60	R976	11.50	R645	13.50
100-125	R643	12.50	R646	14.50

Off-normal springs; 1A, 1B; #ONSI ..... 1.00 extra
(Please specify if required)

FTR TYPE 30; "Homing" type; Single coil; Step in one direction; Beryllium copper arms and contacts; 1B. interrupter spring.

4 Circuit; 30 Positions; 1 Bridging, 3 nonbridging wipers; 1 D (make before break) off-normal spring; Net weight 2 lb.

#R1668 6 to 12 VDC	20.00*
#R1669 24 to 36 VDC	20.00*
#R1670 48 to 60 VDC	20.50*
#R1671 100 to 125 VDC	21.00*

CLARE TYPE 20: "Homing" type; Single coil; Step in one direction; 180° wipers; 20 position: 8 levels, 2 bridging, 6 non-bridging; Phosphur bronze arms and contacts; 1A, 1B, interrupter springs. Net weight 22 oz.

#R1645 6 to 12 VDC	20.00*
#R1646 24 to 36 VDC	20.00*
#R1647 48 to 60 VDC	20.50*
#R1648 100 to 125 VDC	21.00*

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CATALOG I.C.S.

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Resonant reed relays permit the transmission of a number of control signals over a signal wire, carrier or radio circuit. Since a given resonant relay will respond only to a narrow band of frequencies, it is possible to operate a number of relays simultaneously by making use of an equal number of source generators arranged so that none of the operating frequency bands overlap. In the range 200-500 cycles it is possible to operate up to sixteen channels with no interference between channels. 15 frequencies available. All 116 turns, 0.4 ohms d-c:

AVAILABLE FREQUENCIES (CPS)

200.0	240.2	286.6	346.6	416.3
212.6	255.4	306.7	369.3	470.5
226.0	271.3		391.8	

FRAHM RESONANT REED RELAY
(Specify Frequency) 6.00 ea.*

PLUG-IN SEALED RELAYS

POTTER BRUMFIELD SM-TERADIO 6000-BABCOCK BR1

Small (¾" dia x 1-¾"lg), SPDT light weight, hermetically sealed relay in cylindrical shell with 7-pin miniature base.

Stock #	Mfgr #	Volts DC	Ohms	Contact Amps	Case	Ea*
R2552	P&B SM	1 amp	2	½	Metal	3.00
R1337	P&B SM	24	380	½	Glass	2.00
R1338	P&B SM	4.5ma	9000	½	Glass	3.75
R1340	P&B SM	24	900	½	Metal	3.25
R2553	P&B SM	5ma	3500	½	Metal	3.75
R1795	P&B SM	3.8ma	5000	½	Metal	4.00
R822	P&B SM	70	5000	½	Metal	3.25
R2554	P&B SM	3.7ma	8000	½	Metal	4.00
R1441	P&B SM	3 ma	10000	½	Metal	4.00
R1705	Teradio	3 ma	5000	1	Metal	4.50
R2556	Babcock	3.9ma	9000	2	Metal	4.75

TELEPHONE TYPE RELAYS

LONG TYPE

The Telephone Type Relay is the basic all-purpose relay. It is suitable, in its various modifications, for the majority of all applications. It may be mounted in any position and operation is not affected by reasonable vibration. Manufacturing facilities available to us enable us to give prompt delivery of these types of relays in any quantity to your specification. In addition, we have a large supply of interchangeable coils and frames in stock. Let us quote on your requirements.

SMALL TYPE—Compact, versatile, multiple contact, vibration and shockproof, these relays are approximately half the size of the more familiar long telephone type. They are similar to the latter in design and operation. Clare type J, Automatic Electric type E, and Phillips type 8QA are included in this group.

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A Billion Operations

LONG LIFE: Conservative life expectancy of over a billion operations when operated within ratings.

HIGH SPEED: Give consistent performance at speeds up to 60 operations per second.

HIGH CURRENT: and voltage-handling capacity (up to 5 amperes, and up to 500 volts).

UNIFORMITY: Operating time varies by only about 0.1 millisecond under constant drive conditions.

CHATTER-FREE: Mercury dampens armature vibration and bridges mechanical chatter between metal contact surfaces.

CLARE HGP1010: SPDT, Double break (1W); 2 coils: 1020 and 970 ohms; High pressure, hydrogen sealed; Octal plug base. Operates with 15 ma on either coil; Magnetic bias for operation between narrow limits. #R1026 ..... 8.75*

WESTERN ELECTRIC 275C: SPDT, double break; 2 coils, 3300 & 700 ohms; Operating current, windings in series 6.6 ma, release 5.2 ma; #R2551 ..... 8.75*

WESTERN ELECTRIC 276A: SPDT, double break (1W); 90 ohm; Operating current: 16.0 ma; Release 1.3. Magnetic bias; Positive potential must always be applied to start of winding. #R1027 ..... 8.75*

WESTERN ELECTRIC D171584: (Equivalent to 275B); SPDT; 1 coil, 4500 ohm, plus 24 V. heater; relay operating current 8.0 ma, Release current 5.2 ma. The heater is enclosed within the housing to assure uniform high-speed operation even at sub-zero temperatures. #R1021. ..... 8.75*

WESTERN ELECTRIC D168479: (Equivalent to 275C); SPDT 2 coils, 3300 & 700 ohms; Operating current, windings in series, 6.6 ma; release 5.2. #R1022 ..... 8.75*

WESTERN ELECTRIC GA50143: SPDT; 2 coils, 3300 & 700 ohm; Operating current with coils in series: 6.0 ma; Release 3.4 ma. Same as R1022 except more sensitive. #R1019 9.00*

WESTERN ELECTRIC 163781: High speed dry complement to the mercury relay. SPST; 2500 ohm; 24VDC; minimum operating current: 4 ma; Release, 2.9 ma. #R1028 ..... 7.50*

WRITE OR PHONE WAlker 5-9257
FOR YOUR RELAY REQUIREMENTS

We have a variety of standard type of relays. When inquiring concerning your needs, give as much information as possible.

ALL MERCHANDISE IS GUARANTEED AND MAY BE RETURNED FOR FULL CREDIT.

Prices listed with asterisk (*) are subject to QUANTITY DISCOUNTS

1-9	as quoted	50-99	15%
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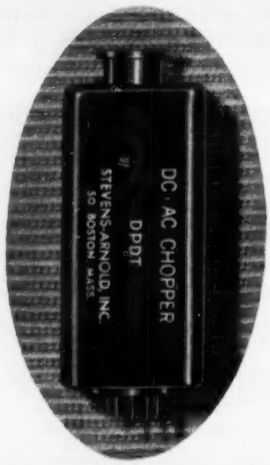

DC-AC CHOPPERS

For 50/60/94/120 Cycle Use

There are twenty-two miniature types, both single and double pole, built to rigid commercial specifications with the emphasis on long life, low noise level, and extreme reliability. Please write for Catalog 515.

MICROVOLT MODULATORS

VIBRATING CAPACITOR

A vibrating-reed type capacitance modulator used to measure currents as low as 10^{-16} amperes. Drift never exceeds ±0.2 millivolts per day, noncumulative. Thus it is ideal where stable performance without recalibration is required for periods of a month or more. Write for Catalog 523.

ULTRA HIGH SPEED RELAYS

Operating time 200 microseconds. Mount in any position. Will cover the range of —65°C to +85°C factory sealed. Please write for Catalog 337.

0-500 CYCLE DC-AC CHOPPERS

Liberal factors of safety. Before any Chopper is shipped, it is tested twice over the range of —65°C to +85°C to give double proof of stamina. Please write for Catalog 280.

RESONANT RELAYS

Permit remote control by radio or carrier through frequency discrimination. Relays operate only when energized at rated frequencies and reject all others. Please write for Catalog 335.

STEVENS-ARNOLD

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Edison Industries T A
Electric Regulator
Electro-Autosizing
Federal Pacific
General Automatic
Gulton Industries
Hillburn Electronic
James Vibrapowr Co
Kurman Electric Co
Larson Instrument
Leach Relay
Millivac Instr Div
North Electric Co
Pollak Corp Jos
Powers Regulator
Relay Sales Inc
Relay Service Co
Simpson Electric
Stevens-Arnold
Victory Engrg Corp
Ward Leonard Electric
Westinghouse Electric
Weston Instruments

RELAYS, Mercury (see also Switches, Mercury)

Allied Control Co
Automatic Electric
Durakool Inc
Ebert Electronics
Energy Kontrols
Gordos Corp
H-B Instrument
Mack Electric Devices
McIlvaine O T
Mercoid Corp
Philadelphia Scien Glass
Relay Sales Inc

RELAYS, Mercury Tube

Berneo Engrg Corp
Ebert Electronics
Gordos Corp
H-B Instrument
Mack Electric Devices
Mercoid Corp
Philadelphia Scien Glass
Relay Sales Inc

RELAYS, Motor Driven, Time Delay

Abrams Instrument
Advance Relays
Alina Corp
Allen-Bradley
Cramer Controls
Curtiss Wright
Eagle Signal
Ebert Electronics
GE Apparatus Sales Div
Hamilton Watch Co
Haydon Co A W
Industrial Timer Corp
Kurman Electric Co
Leach Relay
North Electric Co
Relay Sales Inc
Westinghouse Electric

RELAYS, Movable Coil AC

Advance Relays
Federal Pacific
Hillburn Electronic
Kurman Electric Co
North Electric Co
Relay Sales Inc

RELAYS, Overload

Advance Relays
Allen-Bradley
Allied Control Co
Allis Chalmers
Amer Kloeckner-Moeller
Assembly Products Inc
Automatic Switch Co
Clare & Co C P
Clark Controller
Comar Electric
Cutler-Hammer
E-T-A Products
Ebert Electronics
Electric Regulator
Filtors Inc
G-V Controls
General Automatic
GE Apparatus Sales Div
General Railway Signal
Hughes Products
Jennings Radio Mfg
Kurman Electric Co
Larson Instrument
Leach Relay
Magnecraft Electric
Metals & Controls Div
Naybor Labs E V
North Electric Co
Opad Electric
Pollak Corp Jos
R-B-M Controls Div
Relay Sales Inc
Sigma Instruments
U S Relay Co
Ward Leonard Electric
Weston Instruments
Wheelock Signals Inc

RELAYS, Permanent-Magnet Movable Coil (D'Arsonval Type)

Assembly Products Inc
Automatic Switch Co
Federal Pacific
Kurman Electric Co
Larson Instrument
North Electric Co
Triplett Electl Instr
Weston Instruments

RELAYS, Photoelectric

Allied Radio
Autotron Inc
Berkeley Dynamics
Clark Controller
Comar Electric
Edison Industries T A
Energy Kontrols
Farmer Electric
GE Apparatus Sales Div
Kurman Electric Co
Machinery Electrification
McIlvaine O T
Photobell Co
Photomation Inc
R-B-M Controls Div
Relay Service Co
Sigma Instrument
Tri-Tronics Co
Victory Engrg Corp
Weston Instruments
Worner Electronic Devices

RELAYS, Pneumatic

Advance Relays
Bailey Meter Co
Berneo Engrg Corp
Black Sivalls & Bryson
Conoflow
Eagle Signal
General Regulator
Hagan Chem & Controls
Moore Products Co
North Electric Co
Powers Regulator
Taylor Instrument

RELAYS, Polarized

Advance Relays
Allied Control Co
Automatic Electric
Barber-Colman
Bristol Co
Clare & Co C P
Clark Controller
Edison Industries T A
Electric Regulator
GE Apparatus Sales Div
General Railway Signal
Hart Mfg Co
Hillburn Electronic
James Vibrapowr Co
Kurman Electric Co
Larson Instrument
Leach Corporation
Luther Mfg Co
North Electric Co
Potter & Brumfield
Relay Sales Inc
Sigma Instruments
Stevens-Arnold
U S Relay Co
Wheelock Signals Inc

RELAYS, Power

Advance Relays
Allied Control Co
Automatic Electric
Automatic Switch Co
Automation Controls Corp
Clare & Co C P
Clark Controller
Comar Electric

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Cutler-Hammer
Durakool Inc
Ebert Electronics
Electric Regulator
Energy Kontrols
Filtors Inc
GE Apparatus Sales Div
Globe Electrical
Hart Mfg Co
Hillburn Electronic
James Vibrapowr Co
Leach Corporation
Kurman Electric Co
Mack Electric Devices
Magnecraft Electric
McIlvaine O T
Molex Products
Naybor Labs E V
North Electric Co
Pollak Corp Jos
R-B-M Controls Div
Relay Sales Inc
Sigma Instruments
Potter & Brumfield
Unit Process Assemblies
U S Relay Co
Victory Engrg Corp
Ward Leonard Electric
Welch Electric
Wheelock Signals Inc

RELAYS, Sensitive

Advance Relays
Allied Control Co
Assembly Products Inc
Automatic Electric
Automatic Switch Co
Automation Controls Corp
Barber-Colman
Baso Inc
Comar Electric
Corbett Science Labs
Cutler-Hammer
Ebert Electronics
Edison Industries T A
Electric Regulator
Federal Pacific
General Automatic
GE Apparatus Sales Div
General Railway Signal
Globe Electrical
H-B Instrument
Hart Mfg Co
Hillburn Electronic
Hughes Products
Iron Fireman Elx Div
Jaidinger Mfg
Kurman Electric Co
Larson Instrument
Leach Corporation
Mack Electric Devices
Magnecraft Electric
Molex Products
North Electric Co
Opad Electric
Philadelphia Scien Glass
Pollak Corp Jos
Potter & Brumfield
Precision Thermometer
Reisner Mfg Co W H
Relay Sales Inc
Relay Service Co
Sigma Instruments
Union Switch & Signal
U S Relay Co
Victory Engrg Corp
Ward Leonard Electric
Warrick Co Chas F
Weston Instruments
Wheelock Signals Inc

RELAYS, Stepping

Automatic Electric
Clare & Co C P
Corbett Science Labs
Cunningham Son & Co
GE Apparatus Sales Div
General Railway Signal
Hillburn Electronic
Leland Inc G H
Land-Air Inc
North Electric Co
Potter & Brumfield
Relay Sales Inc
Sigma Instruments
Stromberg-Carlson Co

RELAYS, Subminiature

Advance Relays
Aero Electronics
Allied Control Co
Amerelay Corp
Automation Controls Corp
Baso Inc
Clare & Co C P
Comar Electric
Dialtron Corp
Filtors Inc
GE Apparatus Sales Div
Gulton Industries
Hart Mfg Co
Hillburn Electronic
Hufco Industries
Hughes Products
Iron Fireman Elx Div
Jaidinger Mfg
Kurman Electric Co
Leach Corporation
Luther Mfg Co
Magnecraft Electric
Naybor Labs E V
North Electric Co
Potter & Brumfield
Relay Sales Inc
Sigma Instruments
Union Switch & Signal
U S Relay Co
Victory Engrg Corp
Wheelock Signals Inc

RELAYS, Telephone, Auxiliary Ringing

Advance Relays
Allied Control Co
Automatic Electric
Automation Controls Corp
Comar Electric
General Automatic
GE Apparatus Sales Div
Globe Electrical
Hillburn Electronic
Hufco Industries
Kurman Electric Co
North Electric Co
Potter & Brumfield
R-B-M Controls Div
Relay Sales Inc
Stromberg-Carlson Co
U S Instrument Corp
U S Relay Co
Wheelock Signals Inc

RELAYS, Temperature

Advance Relays
Baso Inc
Blue M Electric
Dialtron Corp
E-T-A Products
Electric Regulator
General Automatic
GE Apparatus Sales Div
Hughes Products
Kurman Electric Co
Larson Instrument
Lewis Engrg Co
Magnecraft Electric
Philadelphia Scien Glass
Pollack Corp Jos
Powers Regulator
Sigma Instruments
Victory Engrg Corp

RELAYS, Temperature-compensated

Advance Relays
Baso Inc
Curtiss Wright
Edison Industries T A
Electric Regulator
G-V Controls
General Automatic
GE Apparatus Sales Div
Globe Electrical
Luther Mfg Co
Pollak Corp Jos
Sigma Instruments
U S Relay Co
Victory Engrg Corp

RELAYS, Time Delay

A'G'A' Division
Abrams Instrument
Advance Relays
Allied Control Co
Alto Scientific
Amperite Co
Anadex Instruments Inc
Automatic Electric
Automatic Switch Co
Automatic Timing & Contls
Automation Controls Corp
Baso Inc
Clare & Co C P
Clark Controller
Comar Electric
Cramer Controls
Curtiss Wright
Cutler-Hammer
Dialtron Corp
Durakool Inc
E-T-A Products
Eagle Signal
Ebert Electronics
Edison Industries T A
Energy Kontrols
G-V Controls
General Automatic
General Controls
GE Apparatus Sales Div
General Railway Signal
Globe Electrical
Hamilton Watch Co
Haydon Co A W
Hughes Products
Industrial Timer Corp
Jaidinger Mfg
Kurman Electric Co
Larson Instrument
Leach Corporation
Machinery Electrification
Magnecraft Electric
Master Specialties
McIlvaine O T
Naybor Labs E V
North Electric Co
R-B-M Controls Div
Relay Sales Inc
Rhodes Inc M H
Syracuse Electronics
Tempo Instrument
United Control Corp
U S Instrument Corp
U S Relay Co
Victory Engrg Corp
Waugh Engrg Co
Westinghouse Director Sys
Westinghouse Electric
Wheelock Signals Inc
Wilson & Co G C

RELAYS, Transformer, Low Voltage

Advance Relays
Automatic Timing & Contls
B/W Controllers
Ebert Electronics
G-V Controls
General Controls
Gulton Industries
Kurman Electric Co
Mercoid Corp
North Electric Co
Warrick Co Chas F

RELAYS, Vacuum Contact

Allied Control Co
Ebert Electronics
Eitel-McCullough
GE Apparatus Sales Div
Jennings Radio Mfg
Mack Electric Devices
Philadelphia Scien Glass

RELAYS, Vibrating Reed Type

Automatic Electric
Biddle Co James G
Bulova Research
Electronic Computer Co
Jaidinger Mfg
North Electric Co
Stevens-Arnold

RESISTORS, Adjustable

Allen-Bradley
Bourns Inc
Centralab Div
Clark Controller
Clarostat Mfg
Electric Regulator
International Resistance
Mallory & Co P R
Precision Inc
Precision Line Inc
Rex Rheostat
Ward Leonard Electric

RESISTORS, Deposited Carbon

Aerovox Corp
Amperite Co
Centralab Div
Clarostat Mfg
Corning Glass
Electra Mfg
Erie Resistor
International Resistance
Mallory & Co P R
Optical Coating Lab

RESISTORS, Ballast

Clarostat Mfg
Ohio Carbon Co
Precision Resistor Co

RESISTORS, Carbon Composition and/or Variable

Aero Electronics
Aerovox Corp
Allen-Bradley
Centralab Div
Clarostat Mfg
Erie Resistor
International Resistance
Mallory & Co P R
Ohio Carbon Co
Reon Resistor Corp
Stackpole Carbon
White Dental Mfg

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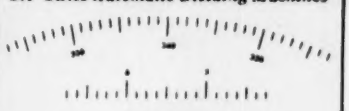

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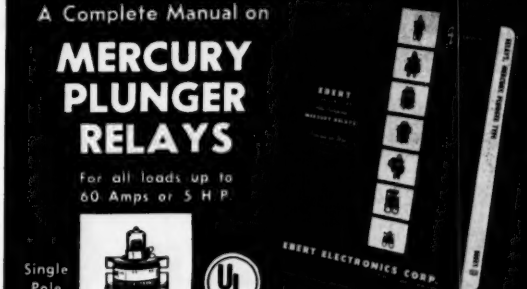

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RESISTORS, Encapsulated
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Allen-Bradley
Centralab Div
Clarostat Mfg
Corning Glass
Daven Co
Dovcon Corp
Dmeter Mfg
Electra Mfg
Electro Instruments
Erie Resistor
General Resistance
Gordos Corp
International Resistance
Julie Research Labs
Kelvin Electric
Mallory & Co P R
Non-Linear Systems
Precision Inc
Precision Resistor Co
Reon Resistor Corp
Shallcross Mfg Co
Ultronix Inc
Weston Instruments

RESISTORS, High Frequency
Aerovox Corp
Clarostat Mfg
Corning Glass
Electra Mfg
International Resistance
Julie Research Labs
Mallory & Co P R
Transformers Inc
Weston Instruments

RESISTORS, High Megohm
Allen-Bradley
Centralab Div
Clarostat Mfg
Corbett Science Labs
Daven Co
Julie Research Labs
K-F Development
Kelvin Electric
Reon Resistor Corp
Shallcross Mfg Co
Weston Instruments
White Dental Mfg

RESISTORS, High Voltage
Centralab Div
Clarostat Mfg
Corbett Science Labs
Corning Glass
International Resistance
Julie Research Labs
K-F Development
Mallory & Co P R
Precision Resistor Co
Ram Meter Inc
Shallcross Mfg Co
Weston Instruments
White Dental Mfg

RESISTORS, Manganin
Daven Co
Dmeter Mfg
General Resistance
Gray Instrument
Industrial Instruments
Julie Research Labs
K-F Development
Kelvin Electric
M-H Rubicon Instrs Div
Precision Inc
Precision Resistor Co
Ram Meter Inc
Reon Resistor Corp
Rinco Inc
Shallcross Mfg Co
Weston Instruments
Winslow Company Inc

RESISTORS, Molded
Aerovox Corp
Allen-Bradley
Clarostat Mfg
Daven Co
Electra Mfg
General Resistance
International Resistance
Julie Research Labs
K-F Development
Precision Resistor Co
White Dental Mfg

RESISTORS, Negative Temperature Coefficient
Aerovox Corp
Daven Co
Dmeter Mfg
Electra Mfg
GE Magnetic Materials
General Resistance
Kelvin Electric
Victory Engrg Corp

RESISTORS, Noninductive
Aerovox Corp
Allen-Bradley
British Industries
Clarostat Mfg
Corning Glass
Daven Co
Dmeter Mfg
Electra Mfg
Electro Instruments
General Radio
General Resistance
Gray Instrument
Industrial Instruments
Julie Research Labs
K-F Development
Kelvin Electric
Precision Inc
Precision Resistor Co
Reon Resistor Corp
Resistors Inc
Rex Rheostat
Rinco Inc
Shallcross Mfg Co
States Company
Ward Leonard Electric
Weston Instruments

RESISTORS, Precision (accuracy better than 1%)
Aerovox Corp
Allen-Bradley
British Industries
Corbett Science Labs
Clarostat Mfg
Corning Glass
Daven Co
Dmeter Mfg
Electra Mfg
Electro Instruments
Electro-Measurements
Electronic Applications
Erie Resistor
General Radio
General Resistance
General Transistor
Gray Instrument
Industrial Instruments
International Resistance
Julie Research Labs
K-F Development
Kelvin Electric
Leeds & Northrup
M-H Rubicon Instrs Div
Mallory & Co P R
Muirhead Instrs Inc
Networks Elx Corp
Non-Linear Systems
Precision Inc
Precision Line Inc
Precision Resistor Co
Reon Resistor Corp
Sage Electronics
Shallcross Mfg Co
Transformers Inc
Weston Instruments
Ultronix Inc
Winslow Company Inc

RESISTORS, Tape
International Resistance
K-F Development

RESISTORS, Wire Wound (2 watts and under)
Aero Electronics
Aerovox Corp
Carol Electronics
Centralab Div
Clarostat Mfg
Daven Co

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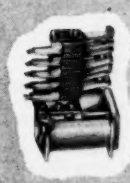

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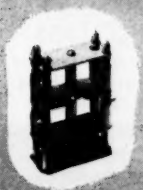

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Industrial Instruments
International Resistance
Julie Research Labs
K-F Development
Kelvin Electric
Mallory & Co P R
M-H Rubicon Instru Div
Model Engrg
Muirhead Instrs Inc
Non-Linear Systems
Precision Inc
Precision Line Inc
Precision Resistor Co
Reon Resistor Corp
Rinco Inc
Sage Electronics
Shallcross Mfg Co
Ultronix Inc
Weston Instruments

RESISTORS, Wire Wound (2 to 500 watts) (see also Rheostats)

Aero Electronics
Centralab Div
Clark Controller
Clarostat Mfg
Dmeter Mfg
GE Apparatus Sales Div
General Radio
Hardwick Hindle
International Resistance
Mallory & Co P R
Microloc Corp
Model Engrg
Ohio Carbon Co
Precision Inc
Ram Meter Inc
Resistors Inc
Rex Rheostat
Sage Electronics
Shallcross Mfg Co
Ward Leonard Electric
Weston Instruments

RESISTORS, Wire Wound (500 to 1500 watts) (see also Rheostats)

Clark Controller
GE Apparatus Sales Div
International Resistance
Model Engrg
Ram Meter Inc
Rex Rheostat
Ward Leonard Electric
Westinghouse Electric
Weston Instruments

RESISTORS, Woven

Clarostat Mfg
States Company

RETICLES

Bushnell & Co D P
Leroy M E Clausing
Levy & Co Max
Paloc Optical Co
Photoplating Co
Renick Co L C
Zenith Optical Lab

RHEOSTATS, Field

Clark Controller
Clarostat Mfg
Cutler-Hammer
GE Apparatus Sales Div
Mallory & Co P R
Ward Leonard Electric
Westinghouse Electric

RHEOSTATS, Slide Wire and Variable (see also Resistors)

Aero Electronics
Allen-Bradley
Biddle Co James G
Bourns Inc
Clarostat Mfg
DeJur-Amsco
General Controls
General Radio
Hardwick Hindle
Mallory & Co P R
Model Rectifier
Precision Line Inc
Rex Rheostat
Rinco Inc
Supervisor Electric Co
Ward Leonard Electric
Welch Scientific
Westinghouse Electric

SCALES, Instrument

American Laubscher
Bushnell & Co D P
Crename Inc
Eagle Equipment
Gaertner Scientific
Gurley W & L E
Levy & Co Max
Metalphoto Corp
Photoplating Co
Renick Co L C
Sensitive Research Instr
U S Radium Corp
Waldom Electronics

SOLENOIDS, (see also Relays)

Allen-Bradley
Applied Dynamics
Automatic Electric
Automatic Switch Co
B/W Controllers
Carruthers & Fernandes
Comar Electric
Controls Co of Amer
Cunningham Son & Co
Cutler-Hammer
Detroit Coil Co
GE Apparatus Sales Div
Induction Motors Corp
Kintronic Div
Koontz-Wagner Elec
Leetronics Inc
P S P Engrg Co
Pollak Corp Jos
R-B-M Controls Div
Relay Sales Inc
Synchro-Start
U S Relay Co
Welch Electric
Weston Hydraulics Ltd

SOLENOIDS, Rotary

Carruthers & Fernandes
Curtiss-Wright
Land-Air Inc
Leetronics Inc
Leland Inc G H
Pacsol Div
Relay Sales Inc

SOLENOIDS, Subminiature

Cannon Electric
Carruthers & Fernandes
Comar Electric
Controls Co of Amer
Cunningham Son & Co
Induction Motors Corp
Kintronic Div
Koontz-Wagner Elec
Leetronics Inc
Pollak Corp Jos
P S P Engrg Co
Relay Sales Inc

STANDARD CELLS

Eppley Laboratory
International Rectifier
Muirhead Instrs Inc
North Hills Electric
Sensitive Research Instr
Winslow Company Inc

SWITCHES, Air Operated

Aero Division
Bristol Co
Carruthers & Fernandes
Calvin Labs
Consol Controls
Dietz Co Henry G
Electric Regulator
Fairchild Controls
Furnas Electric
GE Apparatus Sales Div
Gorn Electric
Haydon Switch Inc
Johnson Service Co
Linear Controls
Mercoid Corp
Newark Controls
Powers Regulator
Rotary Devices Corp
Westinghouse Electric

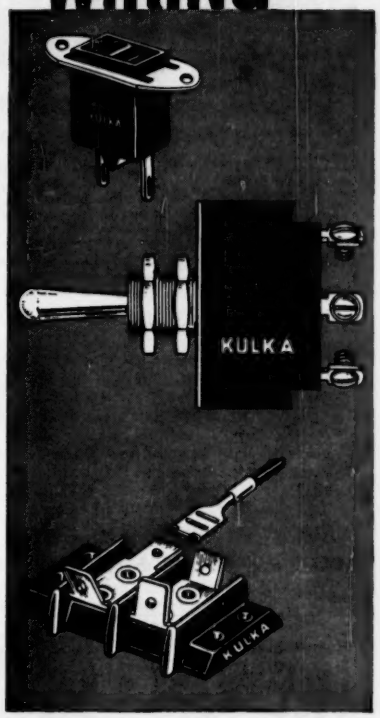
SWITCHES, Instrument, including Wiping, Selecting, etc

Aerovox Corp
Applied Science Corp
Automatic Electric
Automatic Metal Prods
Centralab Div
Clarostat Mfg
Cunningham Son & Co
Cutler-Hammer
Daven Co
Digitran Co
Electric Regulator
Electro Development
Electrosnap
Federal Pacific
General Devices
Grayhill Inc
Hughes Products
Industrial Instruments
Land-Air Inc
Lewis Engrg Co
Lind Corp
Mallory & Co P R
M-H Micro Switch Div
Model Engrg
Muirhead Instrs Inc
North Electric Co
Pollak Corp Jos
Poly-Scientific Corp
Relay Sales Inc
Rotary Devices Corp
Shallcross Mfg Co
Taurus Corp
Therme Electric
U S Instrument Corp

SWITCHES, Magnetic

Aero Division
Allen-Bradley
Automatic Electric
Clark Controller
Cutler-Hammer
E-T-A Products
Ebert Electronics
Electrosnap
Furnas Electric
General Devices
GE Apparatus Sales Div
Gordos Corp
Hamlin Inc
Hughes Products
Mercoid Corp
Molex Products
Murphy Mfg Inc
North Electric Co
Philadelphia Scien Glass
Post Electronics
Rotary Devices Corp

SIMPLIFY THAT WIRING



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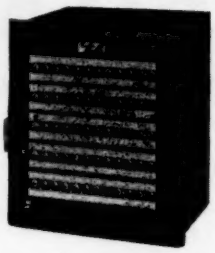
SWITCHING SYSTEMS

For Thermocouples or Resistance Bulb Circuits



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T-E's variety of compact, durable switching systems lets you choose the one best suited to your circuit needs.

Rotary Selector Switch "Shorting-type" switches for quick checking or switching of sensing elements. Maximum, 24 points.

Key Switches Will connect many sensing elements to one instrument or transfer them from one instrument to another. Maximum, 144 points.

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AP-153 WEIGHT: 1¾ lbs.

FOR MEDIUMS NOT INJURIOUS TO STEEL OR SILVER SOLDER

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VISIBLE CIRCUIT

CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front).

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Adjustable Operating Range	Differential Fixed (Factory Set)	Maximum Surge Limits
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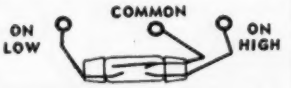
CIRCUIT

SP-DT HERMETICALLY SEALED MERCURY SWITCH (4A. 115V., 2A. 230V.)



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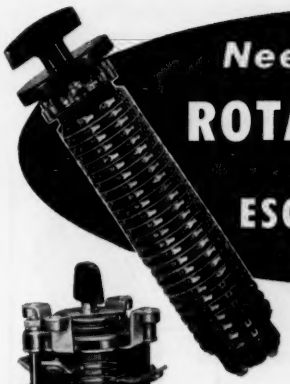

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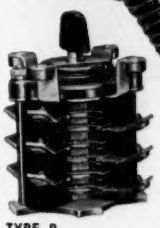

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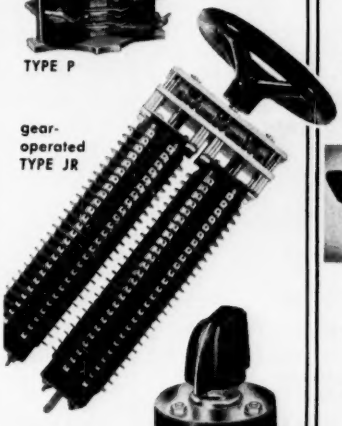
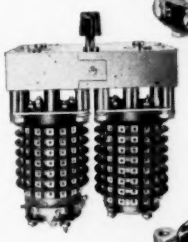
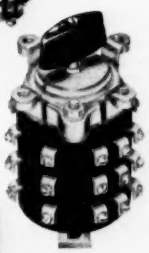


gear-operated TYPE JR

TYPE A/AF



geared pair TYPE HT



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TYPE HT

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A deviation from one of our standard switch assemblies will give you a *special switch* at a standard-switch cost.

Over 90% of our production is *special* in one way or another.

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- *Type P* — Multi-section, up to 4 positions, snap-action, rating 10 amp. 125 volts a-c, 5 amp. 125 volts d-c, 30, 60, 100, 200 amp. 500 volts a-c, or 250 volts d-c. Can be assembled to meet Specification MIL-S-15291.
- *Type JR* — up to 8 positions, 30 sections maximum, detent action, rating 10 amp. 125 volts a-c, 5 amp. 125 volts d-c.
- *Type JD-JS* — up to 8 positions, 5 sections maximum, detent action or snap action, rating 30 amp. 230 volts a-c.
- *Type HT* — up to 16 positions, 10 sections maximum, detent action, rating 5 amp. 125 volts a-c.
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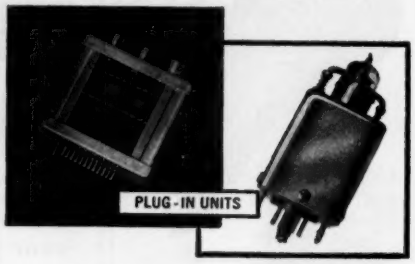
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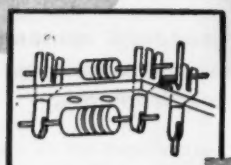
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JUMPER STRIP Eliminates wiring for common circuits
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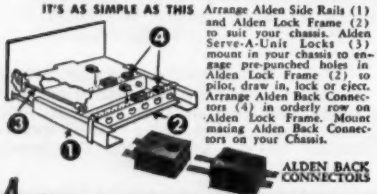
2. To mount this vertical circuitry, ALDEN PLUG-IN PACKAGES AND CHASSIS give tremendous variety with standard components

Alden components provide standard plug-in or slide-in housings—with spares, your circuits become units replaceable in 30 seconds.

3. Give chassis easily traceable interconnects and 30-second replacement with ALDEN SERVE-A-UNIT KIT

IT'S AS SIMPLE AS THIS Arrange Alden Side Rails (1) and Alden Lock Frame (2) to suit your chassis. Alden Serve-A-Unit Locks (3) mount in your chassis to engage pre-punched holes in Alden Lock Frame (2) to pilot, draw in, lock or eject. Arrange Alden Back Connectors (4) in orderly row on Alden Lock Frame. Mount mating Alden Back Connectors on your Chassis.



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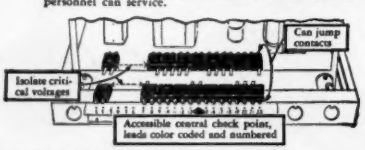

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12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312	332	352	372	
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	353	373	
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	334	354	374	
15	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	335	355	375	
16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	336	356	376	
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	337	357	377	
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	338	358	378	
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	339	359	379	
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3	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	323	343	363	483
4	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	324	344	364	484
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	325	345	365	485
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	326	346	366	
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8	28	48	68	88	108	128	148	168	188	208	228	248	268	288	308	328	348	368	
9	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	329	349	369	
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12	32	52	72	92	112	132	152	172	192	212	232	252	272	292	312	332	352	372	
13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	353	373	
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	334	354	374	
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16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	336	356	376	
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	337	357	377	
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	338	358	378	
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	339	359	379	
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3	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	323	343	363	383	403
4	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	324	344	364	384	404
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	325	345	365	385	405
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	326	346	366	386	
7	27	47	67	87	107	127	147	167	187	207	227	247	267	287	307	327	347	367	387	
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9	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	329	349	369	389	
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13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	353	373	393	
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	334	354	374	394	
15	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	335	355	375	395	
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17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	337	357	377	397	
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	338	358	378	398	
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	339	359	379	399	
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Flexible or semi-flexible—Wrap around or rigid types for accurate measurement of temperatures in aircraft gas turbines, test cells, etc. produced to customer requirements.

▶ **Prototype or production quantities are invited.**

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Transformers Inc
Trenton Transformer
U S Electronics
United Transformer
Universal Toroid Coil
Varo Mfg Co
Virginia Electronics
Warren Transformer
Wells Electronics

TRANSFORMERS, Instrument including Current, and/or Potential, Laboratory

ACDC Electronics Inc
Allis-Chalmers
American Optical Co
Annis Co R B
Associated Research
Basler Electric
Capitron Div AMP
Calif Magnetic Control
Campbell Co
Coast Coil
Davenport Mfg
Del Electronics
Dietz Design
Durakool Inc
Electrosolids Corp
Esterline-Angus
GE Apparatus Sales Div
Goslin Electric
Hevi Duty Electric
Industrial Transformer
Interelectronics
Kelvin Electric
Kavamil Co
Knopp Inc
Landis & Gyr
Mico Instr Co
Microtran Co
N Y Transformer
Ortho Filter Corp
Pearson Electronics
Ram Meter Inc
Sangamo Electric Co
Specialties Inc
Superior Electric Co
Tech Apparatus Bldrs
Transformers Inc
Trenton Transformer
Universal Toroid Coil
Varo Mfg Co
Virginia Electronics
Warren Transformer
Westinghouse Electric
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Calif Magnetic Control
Del Electronics
Durakool Inc
Industrial Instruments
GE Apparatus Sales Div
Industrial Transformer
Kavamil Co
Microtran Co
Peschel Electronics
Tech Apparatus Bldrs
Transformers Inc
Trenton Transformer
United Transformer
Virginia Electronics
Warren Transformer

TRANSFORMERS, Isolation

ACDC Electronics Inc
Ameico Inc
Amplifier Corp of Amer
Audio Development Co
Basler Electric
Calif Magnetic Control
Campbell Co
Carol Electronics
Chicago Std Transformer
Communication Accessories
Del Electronics
Durakool Inc
Elcor Inc
Electrosolids Corp
Freed Transformer
Gates Electronic
Goslin Electric
Green Rectifier
Industrial Transformer
Kavamil Co
Microtran Co
New England Transformer
N Y Transformer
Pacific Instrument Co
Perkin Engrg Corp
Sangamo Electric Co
Specialties Inc
Standard Electrical Prods
Sterling Transformer
Transformers Inc
Trenton Transformer
United Transformer
Varo Mfg Co
Warren Transformer

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Airtron Inc
Basler Electric
Communication Accessories
Durakool Inc
Freed Transformer
Goslin Electric
Industrial Transformer
Kavamil Co
P and H Electronics
Perkin Engrg Corp
Stavid Engineering
Telerad Mfg Corp
United Transformer
Warren Transformer

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ACDC Electronics Inc
Basler Electric
Calif Magnetic Control
Communication Accessories
Durakool Inc
ESC Corp
Freed Transfromer
Goslin Electric
Industrial Transformer
Interelectronics
Kavamil Co
Microtran Co
N Y Transformer
P and H Electronics
Perkin Engrg Corp
Specialties Inc
Trenton Transformer
United Transformer
Warren Transformer

TRANSFORMER, Power

ACDC Electronics Inc
Airpax Electronics
Ameico Inc
Amplifier Corp of Amer
Audio Development Co
Basler Electric
Calif Magnetic Control
Campbell Co
Capitron Div AMP
Carol Electronics
Carruthers & Fernandez
Chicago Std Transformer
Communication Accessories
Del Electronics
Dietz Design
DJECO
Durakool Inc
EMP Electronics Res Lab
Electron Arc
Electrosolids Corp
Ferranti Electric
Freed Transformer
GE Apparatus Sales Div
General Railway Signal
Goslin Electric
Green Rectifier
Hevi-Duty Electric
Industrial Rectifier
Industrial Transformer
Interelectronics
James Vibrapowr Co
Kavamil Co
Kelvin Electric

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Precise Electrical Measurements
AC-DC and High Frequency
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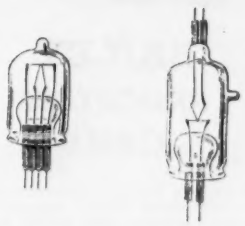

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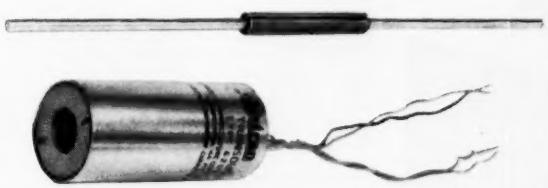

INCREASE SENSITIVITY • SIMPLIFY DESIGN

ATCOTRAN differential transformers translate displacement or position change into linear voltages, providing reliability and infinite resolution where small motions must be accurately measured, recorded or controlled.

ATC's Experimental Kit offers all essential data and components for experimentation and development.

Write for free 32 page "Handbook of Linear Transducers" with theory, characteristics, and applications

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CIRCLE 342 ON READER-SERVICE CARD

Super-Sub-Miniature Transformers

For transistor circuitry

in servo-mechanisms, hearing aids, radios, telephones

- ▶ **High reliability guaranteed.**
- ▶ **Large quantities used, with transistors, by leading manufacturers.**
- ▶ **Some of the most Important prototypes in use today use:**

Type	H	W	D
M-200	.237	.340	.280
F-2010	.263	.410	.325
AAT-408	.307	.376	.325
SM-400	.400	.563	.485
NA-2350	.750	1	.750
GEN-2020	1 1/16"	1 1/4"	7/8"

- ▶ **Immediate delivery from inventory covering wide range of impedance ratios in sub-miniature and super-sub-miniature sizes.**
- ▶ **Prototypes—Designed or wound and enclosed to specifications. . . . Delivery within two weeks.**

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BAILEY

ARMORTUBE CABLE

• Provides flexible, armored, multiple tube transmission lines for pneumatic and hydraulic metering and control systems.

Saves you $5 to $6 per installed foot over tube-by-tube installations. Provides protection from such hazards as falling objects, welding sparks, and corrosive atmospheres. Uses standard electrical cable accessories.

Available in bundles of one to nineteen 1/4" to 1/2" copper or aluminum tubes. Tubes covered by galvanized steel armor or thermoplastic sheath over and/or under galvanized steel armor.

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Bailey Meter Company Ltd., Montreal, Canada

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New England Transformer
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Ortho Filter Corp
Pacific Instrument Co
Penn-East Engrg Corp
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Standard Electrical Prods
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Sterling Transformer
Tech Apparatus Bldrs
Transformers Inc
Trenton Transformer
U S Electronics
United Transformer
Universal Toroid Coil
Varo Mfg Co
Virginia Electronics
Warren Transformer
Westinghouse Electric

TRANSFORMERS, Pulse

ACDC Electronics Inc
Airpax Electronics
Berkshire Laboratories
Calif Magnetic Control
Campbell Co
Capitron Div AMP
Carol Electronics
Chicago Std Transformer
Communication Accessories
Dietz Design
Durakool Inc
EMP Electronics Res Lab
ESC Corp
Esser Electronics
Freed Transformer
GE Apparatus Sales Div
Goslin Electric
Gudeman Co
Hevi-Duty Electric
Industrial Transformer
Kavamil Co
Kelvin Electric
Microtran Co
New England Transformer
N Y Transformer
North Hills Electric
Ortho Filter Corp
PCA Electronics
Pacific Instrument Co
Packard Bell
Pearson Electronics
Perkin Engrg Corp
Polyphase Instr Co
Pulse Engrg Inc
Rixon Electronics
Sangamo Electric Co
Stavid Engineering
Sterling Transformer
Technitrol Engrg
Transformers Inc
United Transformer
Universal Toroid Coil
Valor Instruments
Varo Mfg Co
Warren Transformer
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TRANSFORMERS, Split Core

ACDC Electronics Inc
Annis Co R B
Arnold Engineering
Basler Electric
Calif Magnetic Control
Capitron Div AMP
Carruthers & Fernandes
Communication Accessories
Dietz Design
Durakool Inc
EMP Electronics Res Lab
Freed Transformer
GE Apparatus Sales Div
Goslin Electric
Hevi-Duty Electric
Industrial Transformer
Interelectronics
James Vibrapowr Co
Knopp Inc
Microtran Co
N Y Transformer
Perkin Engrg Corp
Tech Apparatus Bldrs
Transformers Inc
Trenton Transformer
Universal Toroid Coil
Varo Mfg Co
Warren Transformer

TRANSFORMERS, Ultrasonic

Audio Development Co
Basler Electric
Calif Magnetic Control
Dietz Design
Durakool Inc
Electron Arc
Ferranti Electric
Freed Transformer
Gulton Industries
Industrial Transformer
Interelectronics
Sangamo Electric Co
Sterling Transformer
Microtran Co
N Y Transformer
North Hills Electric
Pearson Electronics
Transformers Inc
Trenton Transformer
Warren Transformer

TRANSFORMERS, Variable, including Autotransformers

Airpax Electronics
Allis-Chalmers
Avionic Supply
Basler Electric
Calif Magnetic Control
Canadian Marconi
Chicago Std Transformer
Del Electronics
Dietz Design
Durakool Inc
Eastern Specialty Co
Electron Arc
Electrosolids Corp
Freed Transformer
Gates Electronic
GE Apparatus Sales Div
General Radio
Green Rectifier
Hevi-Duty Electric
Industrial Rectifier
James Vibrapowr Co
Kavamil Co
Land-Air Inc
Microtran Co
Pacific Instrument Co
Schaevitz Engineering
Standard Electrical Prods
Superior Electric Co
Tech Apparatus Bldrs
Trenton Transformer
United Transformer
Universal Toroid Coil
Virginia Electronics
Westinghouse Electric

TRANSFORMERS, Variable, Voltage Testing

Basler Electric
Calif Magnetic Control
Dietz Design
Durakool Inc
Electron ARC
Gates Electronics
GE Apparatus Sales Div
Green Rectifier
Industrial Transformer
Superior Electric Co
Tech Apparatus Bldrs
United Transformer
Universal Toroid Coil

TRANSISTORS,

Advanced Research
Amperex Electronic
Bourns Inc
CBS Electronics
Clevite Transistor Prods
Delco Radio
DJECO
GE Semicond Prods
General Transistor
Hughes Products
Industro Transistor
Lansdale Tube
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Ramo-Wooldridge
Silicon Transistor
Sylvania Semiconductor
Tech Apparatus Bldrs
Texas Instruments
Transitron Electronic
Westinghouse Electric
Westinghouse Semicond.

TUBES, Cathode Ray, including Display, Camera, Storage, etc.

British Industries
CBS Electronics
Canadian Marconi
Corning Glass
Diamond Power Specialty
DuMont Labs Allen B
Electronic Tube
Ferranti Electric
GE Power Tube Dept
General Electrodynamics
Hughes Products
Intercontinental Elx
Lansdale Tube
Stromberg-Carlson Co
Waterman Products

TUBES, Discharge, Gas and Vapor, including Argon, Mercury, Neon, Sodium, etc.

Amglo Corp.
Amperex Electronic
Aristo Grid Lamp
British Industries
Canadian Marconi
Central Electronic Mfgrs
Electrons
Ferranti Electric
GE Power Tube Dept
Gordos Corp
Hughes Products
Kemlite Labs
Microwave Associates
Wiltec Electronics

TUBES, Electrometer

British Industries
Canadian Marconi
Ferranti Electric
GE Power Tube Dept

TUBES, Electron Vacuum

Amperex Electronic
British Industries
Burroughs Elx Tube
CBS Electronics
Canadian Marconi
Central Electronic Mfrs
Eitel-McCullough
Ferranti Electric
GE Power Tube Dept
Lansdale Tube
Lewis & Kaufman Ltd
Hughes Products
Wiltec Electronics

TUBES, Geiger-Mueller (see also Counters, G-M)

Amperex Electronic
Baird-Atomic Inc
British Industries
Canadian Marconi
Isotopes Specialties
Landsverk Electrometer
Nuclear-Chicago
Nuclear Dev Lab
Nucleonic Corp of Amer
Technical Associates
Wood N Counter Lab

TUBES, Glow (see also Tubes, Discharge)

Amglo Corp
Amperex Electronic
Baird-Atomic Inc
British Industries
Burroughs Elx Tube
Bush Associates G F
Canadian Marconi
Chicago Miniature Lamp
Ferranti Electric
Kemlite Labs
Wiltec Electronics

TUBES, Ignitron

Amperex Electronic
GE Power Tube Dept
Natl Electronics
Westinghouse Electric

TUBES, Klystron

Amperex Electronic
Applied Radiation Corp
British Industries
Canadian Marconi
Eitel-McCullough
GE Power Tube Dept
Hughes Products
Varian Associates

TUBES, Magnetron

Amperex Electronic
British Industries
Canadian Marconi
GE Power Tube Dept
Microwave Associates

TUBES, Photosensitive (including Pototubes and Photocells

Eastman Kodak
Energy Kontrols
GE Power Tube Dept
General Electrodynamics
Greiner Co Emil
Photobell Co
Western Radiation Lab

TUBES, Thyratron

Amperex Electronic
British Industries
Canadian Marconi
Electrons
GE Power Tube Dept
Hughes Products
Natl Electronics
Wiltec Electronics

TUBES, Traveling Wave (see also Microwave Equipment—Cat. 3)

British Industries
Canadian Marconi
Eitel-McCullough
Electronic Tube
GE Power Tube Dept
Hughes Products
Lewis & Kaufman Ltd
Porter Inc Geo K
Varian Associates

TUBES, X-ray

Aeroquip Corp
Amperex Electronic
British Industries
Ferranti Electric
GE X-Ray Dept
Kemlite Labs
Westinghouse Electric

TUBING, Flexible, Multiple Tube Bundles

Airtron Inc
Bailey Meter Co
Breene Corporations
Crescent Insulated Wire
Dekoron Prods Div
Illumitronic Engrg
M and Q Plastic Products
Nylon Moldin
Okonite Co
Penna Fluorocarbon
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VARISTORS

GE Magnetic Materials
Precision Thermometer
Trio Laboratories
Union Switch & Signal
U S Semiconductor Prods
Victory Engrg Corp

VIALS, Level

Bache & Co Semon
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GE Magnetic Materials
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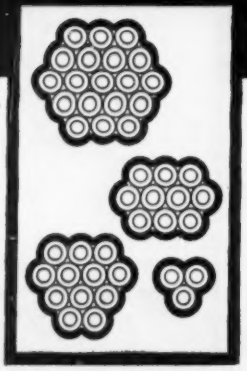
PYRAMID "INSTRUPACK"

(TUBING BUNDLES)

POLYETHYLENE TUBES ENCLOSED IN VIRGIN PVC (VINYL) SHEATH

STANDARD
Tubing—¼" O.D. x .040" Wall, .045" or .062" Sheath
Tubing—⅜" O.D. x .062" Wall, .045" or .062" Sheath



Tough vinyl outer sheath with excellent chemical atmospheric resistance. Inside tubes are Polyethylene available in standard colors with pair of telephone wire leads. Lengths to requirements.

STOCK POLYETHYLENE TUBING—¼" O.D. x .040" wall and ⅜" O.D. x .062" wall, in standard colors.

PLASTIC COATED METAL TUBING—standards and specials to order.

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Machines / Materials

1960 BUYERS' GUIDE

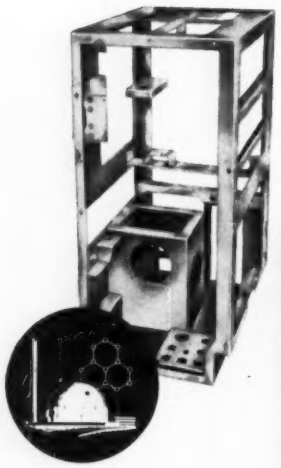
9

MACHINES, TOOLS, ACCESSORIES AND MATERIALS FOR INSTRUMENT MANUFACTURE/ MAINTENANCE

FALSTROM ENCLOSURES FOR EVERY ELECTRONIC INDUSTRY

Falstrom's experience in working metals can help you create the enclosures you need for your instruments, controls, equipment or machinery. Whether you require a complete control room with color-coded graphic panelboards, or a simple chassis, Falstrom facilities and skilled personnel can help you achieve better design and more economical production.

Falstrom metal fabrications — consoles, racks, chassis, weldments, panelboards, enclosures, — are in service throughout American industry. They are produced to customer specifications in steel, aluminum, magnesium, stainless and other metals.



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Falstrom now also offers a line of standardized units that cost less because they are fabricated from stock tools and dies. These units are not shipped from stock but are adapted to the special requirements of the equipment housed. Write today for FREE booklet "How To Get Your Quotation on a Falstrom Standardized Enclosure".

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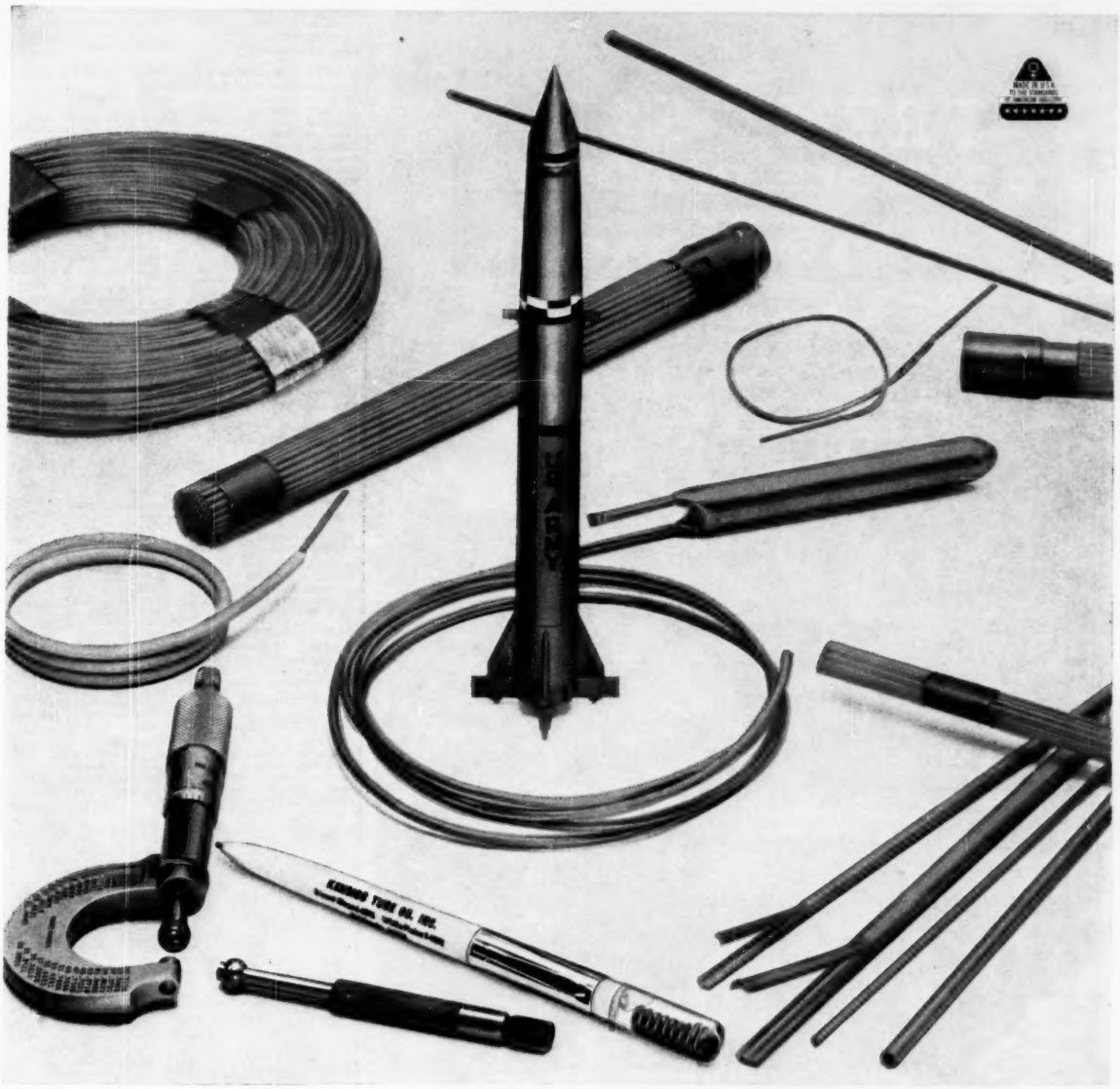

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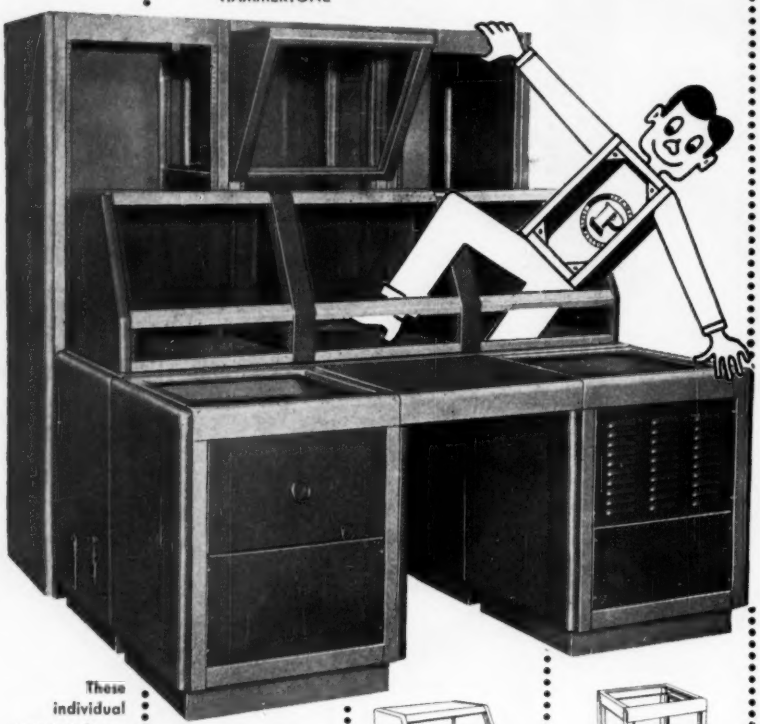

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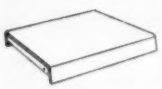
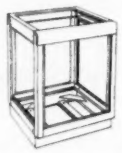


WORK TOP

SLOPING CONSOLE CABINET



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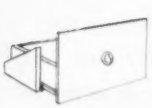
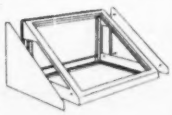


SLIDING DRAWER



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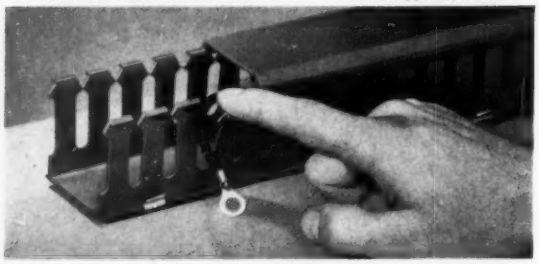

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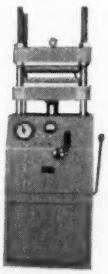

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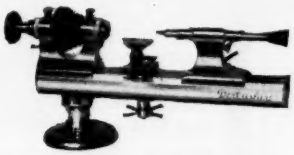

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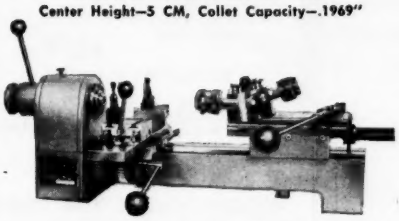

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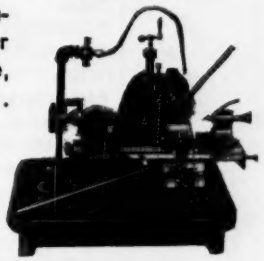

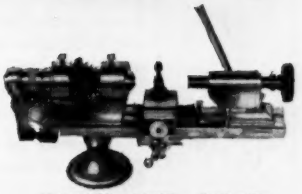

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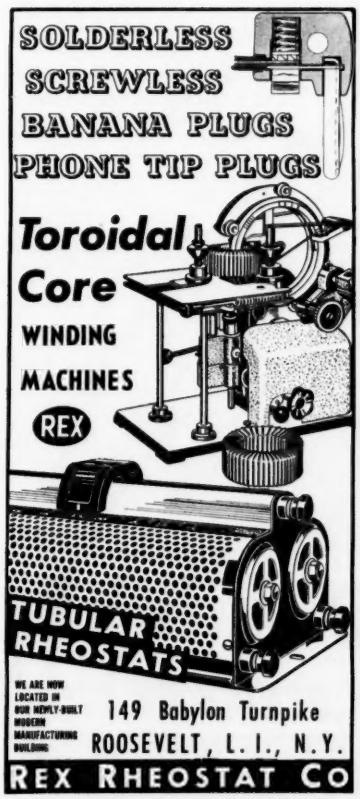

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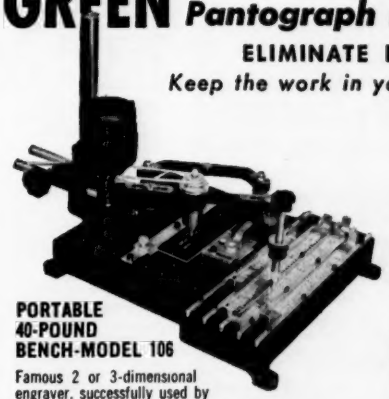

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Continental Screw
Dixon Inc William
H J J Company
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Standard Screw Co
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Accurate Specialties
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Handy & Harman
Superior Flux

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Accurate Specialties
Aluminum Co of Amer
American Smelting
British Industries
Dixon Inc William
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Associated Spring
Crucible Steel
Chatillon John
Elgin Natl Watch
Gordon Enterprises
Hunter Spring Co
Lee Spring Co
Metals & Controls Div
Worden Laboratories

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Elgin Natl Watch
Worden Laboratories

SPRINGS, Torsion
Associated Spring
Chatillon John
Crucible Steel
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Bishop & Co J
Corning Glass
Flexonics Corp
Precision Tube Co
Superior Tube
Uniform Tubes

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Centralab Div
Coors Porcelain
Illumitronic Engrg
McDanel Refractory
Richards Co Arklay S
Saxonburg Ceramics

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Amatom Electronic
Auburn Mfg Co
Continental-Diamond Fibre
General Cement
Illumitronic Engrg
Natl Vulcanized Fibre
Spaulding Fibre Co

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Aeroquip Corp
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Bel Art Products
Breeze Corporations
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Imperial Brass Mfg
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Alpha Wire Corp
Auburn Mfg Co
Brand & Co Wm
Continental-Diamond Fibre
Spaulding Fibre Co
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Natl Vulcanized Fibre
Precision Paper Tube
Richardson Co
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Becker Bros Carbon
Bishop & Co J
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Metals & Controls Div
Porter Inc Geo K
Superior Tube Co
Uniform Tubes

TUBING, Mica
Auburn Mfg Co
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Alleghany Ludlum
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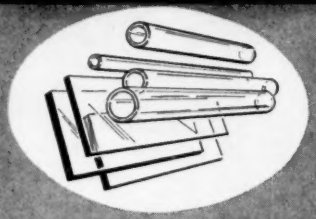

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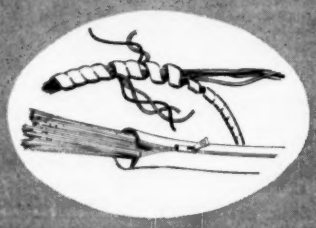

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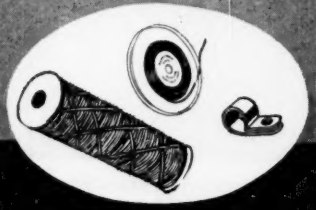

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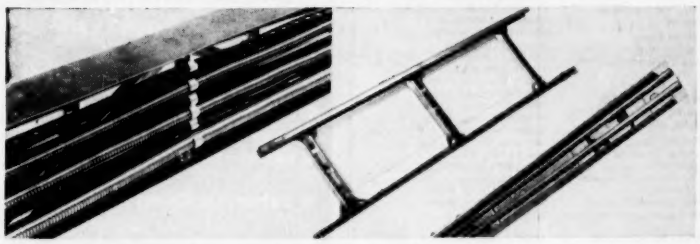

Supports—Expanded and solid metal Trays and Ladder—in *Galvanized Steel* and *Aluminum*, to hold Power and Control Cables and Instrument Tubing. Specified and Approved For All Types of Governmental, Utility and Industrial Jobs.

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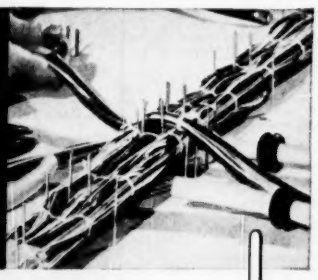
CIRCLE 369 ON READER-SERVICE CARD

SPEED HARNESS ASSEMBLY



with HASSALL HARNESS BOARD POSTS

These new harness posts speed multi-circuit wiring harness assembly. Posts may be nailed into the board with no pre-drilling. Hassall posts are tempered and hardened, nickel plated, and tops are milled round to ease wire placement and removal. Lengths available: 1", 1½", 2", 2½", 3" and 4". Write today for prices.

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NAILS, RIVETS, SCREWS AND OTHER COLD HEADED FASTENERS AND SPECIALTIES

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Uniform Tubes

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Auburn Mfg Co
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Precision Paper Tube

TUBING, Plastic
Ace Plastic Co
Alpha Wire Corp
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Auburn Mfg Co
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Borden Chemical
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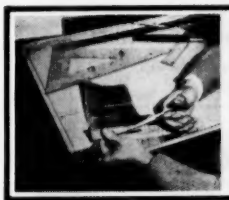

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PLACE the STANPAT into position on the tracing.

PRESS into position . . . will not wrinkle or come off.

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- **Rubber base for standard drafting and tracing papers**
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- **Solid and stranded conductors**
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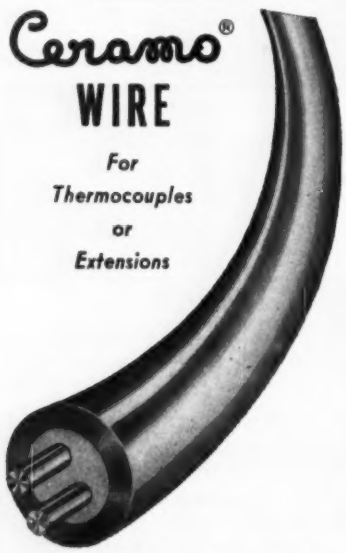
- **Hi-temp overbraid materials**
- **Multi-conductor cables from 6 to 56 pairs**

Ceramo® WIRE

For Thermocouples or Extensions



T-E's "Ceramo" wire does the jobs too tough for ordinary thermocouple wire. "Ceramo's" construction—thermo elements and ceramic insulation encased in seamless metal sheathing—gives it unusual durability. It can be bent on an extremely small radius without shorting or grounding. Outer diameters—just .032" for single conductors and .040" for duplex conductors—permit use in "tight" spots. Larger diameters available up to 7/16".

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- **Temperature ratings up to 3000°F.**

Write for Wire Bulletin 31-FF

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Grinnell Co
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Nylon Moldin
P-W Industries
Panduit Corp

TUNGSTEN, Wire and Products
Bishop & Co
Electronic Parts
Engelhard Industries
Gatti Inc Aurele M
Metals & Controls Div
Victor Equipment

TWEEZERS, Instrument (see also Tools, Precision)
Bishop & Co J
Dixon Inc William
Dyneers
Engelhard Industries
Handicraft Tools

WASHERS, Metal & Plastic
Auburn Mfg Co
Federal Screw Products

WATCHMAKER'S SUPPLIES and TOOLS
Dixon Inc William
Hamilton Watch Co
Kendrick & Davis
L and R Mfg Co
Luxo Lamp Corp
Morris Co J I

WELDING EQUIPMENT
Ewald Instruments
Smith Welding Equip

WICKS FOR WET BULBS
Hill & Co E Vernon

WIRE, Copper, Enameled
Acme Wire Co
Alpha Wire Corp
Electric Auto-Lite
Engelhard Industries
Hitemp Wires Inc
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Wire, Covered
Alpha Wire Corp
Aluminum Co of Amer
Amer Super Temp Wires
Brand & Co Wm
Chester Cable
Electric Auto-Lite
Gordon Co Claud S
Haveg Industries
Lewis Engrg Co
Rockland Insul Wire
Rome Cable Corp
Sequoia Wire
Tensolite Insul Wire
Thermax Wire
Western Insul Wire

WIRE, Fuse
Engelhard Industries
Haveg Industries

WIRE, Insulated, all insulations except enameled and refractory
Acme Wire Co
Alpha Wire Corp
Aluminum Co of Amer
Amer Super Temp Wires
Brand & Co Wm
Chester Cable
Driver Co Wilbur B
Gordon Co Claud S
Haveg Industries
Hitemp Wires Inc
Lewis Engrg Co
Phalo Plastics Corp
Revere Corp of Amer
Rockbestos Products
Rockland Insul Wire
Rome Cable Corp
Sequoia Wire
Tensolite Insul Wire
Thermax Wire
Times Wire & Cable
Western Insul Wire

WIRE, Magnet
Acme Wire Co
Alpha Wire Corp
Aluminum Co of Amer
Amer Super Temp Wires
Crucible Steel
Electric Auto-Lite
Haveg Industries
Hitemp Wires Inc
Illumitronic Engrg
Rockbestos Products
Rome Cable Corp
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WIRE, Metal Shielded
Alpha Wire Corp
Amer Super Temp Wires
Brand & Co Wm
Chester Cable
Electric Auto-Lite
Gordon Co Claud S
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Hitemp Wires Inc
Lewis Engrg Co
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Thermax Wire
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Bishop & Co
Driver Co Wilbur B
Electronic Parts
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Illumitronic Engrg
Paul F H & Stein Bros
Sequoia Wire
Smith Mfg Co Inc
Stretch Wire Corp

WIRE, Nickel, Monel, and Nickel Chromium
Bishop & Co
Crucible Steel
Driver Co Wilbur B
Electronic Parts
Rodale Mfg Co
Sequoia Wire

WIRE, Refractory Insulated
Aero Research Instr
Amer Super Temp Wires
Revere Corp of Amer
Smith Mfg Co Inc

WIRE, Resistance (Platinum or Platinum-Iridium)
Bishop & Co J
Handy & Harman
Metals & Controls Div

WIRE, Resistance, except Platinum and Platinum-Iridium
Carpenter Steel
Driver Co Wilbur B
Gow-Mac Instrument

WIRE, Spring
Bristol Brass
Crucible Steel
Driver Co Wilbur B
Elgin Natl Watch
Hamilton Watch Co
Stretch Wire Corp

WIRE, Thermocouple, Base Metal
Aero Research Instr
Bishop & Co J
Gordon Co Claud S
InstruLab Inc
Leeds & Northrup
Lewis Engrg Co
Metals & Controls Div
Precision Tube Co
Pyrometer Instr Co
Richards Co Arklay S
Smith Mfg Co Inc
Thermo Electric
Thermo Products Co
Times Wire & Cable
West Instrument

WIRE, Thermocouple, Rare Metal
Aero Research Instr
Bishop & Co J
Gordon Co Claud S
InstruLab Inc
Leeds & Northrup
Metals & Controls Div
Richards Co Arklay S
Smith Mfg Co Inc
Thermo Electric
Thermo Products Co
West Instrument

WRENCHES, Socket Instrument
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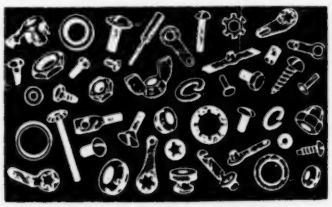

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A

ACDC Electronics, Inc., 2979 N. Ontario St., Burbank, Calif. VI-9-2414

A'G'A Division, Elastic Stop Nut Corp. of America, 1027 Newark Ave., Elizabeth 3, N. J. ELizabeth 2-2900

AMP Inc., Eisenhower Blvd., Harrisburg, Pa. JO-4-0101

Abrams Instrument Corp., 606 E. Shiawassee St., Lansing 1, Mich. IV-4-9441

Accuracy Scientific Instrument Co., 335 E. Chew Ave., Philadelphia 20, Pa. DA 4-5689

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STate 9-8103

Illinois
Rene Bluzat Co.
6322 N. Milwaukee Ave.
CHICAGO 46, Illinois

Massachusetts
Monahan & Co.
P.O. Box 474, NORWOOD, Mass.
NOrwood 7-5961

Middle Atlantic
East Coast Liaison, Inc.
P.O. Box 243
LUTHERVILLE, Maryland

Missouri
Kinrick Co.
222 Olympia Drive
ST. LOUIS, 21, Missouri

Ohio
Callaghan-Bach
2209 Losantiville Road
CINCINNATI 13, Ohio

Upstate New York
Savco, Inc.
124 Kinne Road
EAST SYRACUSE, N. Y.

Accurate Specialties Co. Inc., 37-11 57th St., Woodside 77, N. Y. TW-9-5757

Ace Electronics Assocs., Inc., 99 Dover St., Somerville, Mass. SO-6-5130

Ace Plastic Co., 91-30 Van Wyck Expwy., Jamaica 35, N. Y. JAmaica 3-5500

Ackerman Engravers Inc., 458 Broadway, New York 13, N. Y. BArclay 7-1479

Ackerman-Gould Co., 10 Neil Ct., P.O. Box 188, Ocean Side, L. I., N. Y. ORiole 8-4110
(See advertisement on page 168)

Acme Gauge & Instrument Co., Inc., 30 Main St., Brooklyn 1, N. Y. TR-5-9536

Acme Industrial Co., 200-222 N. Laflin St., Chicago 7, Ill. MO 6-4122

Acme Scientific Co., 1450 W. Randolph St., Chicago 7, Ill. MOnroe 6-1834

Acme Wire Co., 1255 Dixwell Ave., New Haven 14, Conn. LOcust 2-2171

Acro Div., Robertshaw-Fulton Controls Co., 2040 E. Main St., Columbus 16, Ohio. CLearbrook 3-8531

Acoustica Associates, Inc., Fairchild Court, Plainview, New York OVerbrook 1-2100
Dallas Representative
Allied Components Inc.
2517 Converse St., Dallas 7, Texas
Riverside 2-2830

Acromag, Inc., 22519 Telegraph Rd., Detroit 41, Mich. EL-6-7211

Acromark Co., 11 Morrell St., Elizabeth 4, N. J. ELizabeth 2-6500

Acton Laboratories, Inc., 533 Main St., Acton, Mass. COlonial 3-7756
(See advertisement on page 118)

New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Actuator Products Corp., 12 Nashua St., Woburn, Mass. WElls 3-1400

Adage, Inc., 292 Main St. Cambridge 42, Mass. UNiversity 4-7410

Adams Co., R. P., 365 East Park Drive, Buffalo 17, N. Y. VIctoria 2608

Advance Relays Electronics Div., Elgin National Watch Co., 2435 N. Naomi St., Burbank, Calif. VIctoria 9-1446

Advanced Products Co., 59 Broadway, North Haven, Conn. CEdar 9-1664

Advanced Research Associates, Inc., 4130 Howard Ave., Kensington, Md., WHitehall 2-4300

Aero Electronics Corp., 1745 W. 134th St., Gardena, Calif. FAculty 1-2196

Aero Research Instrument Co., Inc. 315 N. Aberdeen St., Chicago 7, Ill. TAylor 9-6400
(See advertisement on page 197)

Aero Research Instrument Co., Inc. Dept. HBG, 315 N. Aberdeen St., Chicago 7, Ill. Phone—TA-9-6400

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Pittsburgh Area Representative
W. A. Stoeltzing, Inc.
940 Western Ave., Pittsburgh 33, Pa.
ALlegheny 1-9400

Aeroquip Corp., 300 S. East Ave., Jackson, Mich. ST 2-0361

Aerotest Laboratories, Inc., 129-11 18th Ave., College Point 56, N. Y. INdependence 1-7272

Aerovox Corp., 740 Belleville Ave., New Bedford, Mass. Wyman 4-9661

Aidlin Automation, Inc., 1613 E. New York Ave., Brooklyn 12, N. Y. EVergreen 5-4246

Ainsworth & Sons, Wm., Inc., 2151 Lawrence St., Denver 2, Colo. ALpine 5-1723

Air Conditioning Equipment Corp., 219 E. 44th St., New York 17, N. Y. MU-7-3099

Airborne Accessories Corp., 1414 Chestnut Ave., Hillside 5, N. J. MU 8-0250

Aircraft Armaments, Inc., Cockeysville, Md. VAlley 5-8400

Air-Maze Corp., 25000 Miles Rd., Cleveland 28, Ohio MOntrose 2-8000

Air-O-Tronics Engineering Co., P.O. Box 31, Lancaster, Calif. WHitehall 3-4654

Airpax Electronics Inc., Seminole Division, Fort Lauderdale, Fla. LUdlow 3-6160

Air-Shields, Inc., Hatboro, Penna. OSborne 5-5200

Airtron Inc., 200 Hanover Ave., Morris Plains N. J. JEfferson 9-5500

Airtronics Inc., 5522 Dorsey Lane, Washington 16, D. C. OLiver 4-1676

Alconox, Inc., 853 Broadway, New York 3, N. Y. GRamercy 3-1300

Alden Products Co., 126-D N. Main St., Brockton, Mass. JUniper 3-0160
(See advertisement on page 182)

Alfa-American Corp., 303 W. 42nd St., New York 36, N. Y.

Alford Manufacturing Co., 299 Atlantic Ave., Boston 10, Mass. HAncock 6-2150

Alfred Electronics, 897 Commercial St., Palo Alto, Calif.

Alina Corp., 122 E. 2nd St., Mineola, L. I., N. Y. PI-7-5336

All American Tool & Mfg. Co., 8027 Lawndale Ave., Skokie, Ill. ORchard 3-7084

Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa. COurt 1-5300

Allegany Instrument Co., Inc., 1091 Wills Mt., Cumberland, Md.
So. Calif.-Ariz.-N. Mex Representative
DyraSales Company
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ANgelus 8-3814

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Miami, Florida

Eastern Pennsylvania-New Jersey Representative
R. E. Weber Company
15 Terry Lane, East Brunswick, N. J.
CLifford 7-5243

Texas-Oklahoma Representative
Don Champion Company
P.O. Box 456
Hurst, Texas

Allen Business Machines, R. C., Inc., 678 Front Ave., N. W. Grand Rapids 4, Mich. GL-6-8541, Ext. 313

Allenair Corp., 255 East 2nd St., Mineola, L. I., N. Y. PL-7-5450
(See advertisement on page 162)

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis. OR-1-2000

Allied Control Co. Inc., 2 East End Ave., New York 21, N. Y. BUtterfield 8-7403

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. HAymarket 1-6800

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. SPring 4-3600. Valve Div., York, Pa.
California Representative (Valve Div.)
Luscombe Engineering Co.
1129 So. Fair Oaks Ave., Pasadena, Calif.
MU 2-3386
130 N. "B" St., San Mateo, Calif. DI 2-7057

All-Tronics, Inc., 45 Bond St., Westbury, L.I., N. Y. ED-3-3090

Almo Mfg. Co., 113-119 Sussex Ave., Newark 3, N. J. HU-2-2185

Alpha Molykote Corp., 65 Harvard Ave., Stamford, Conn. FIreside 8-3724

Alpha Wire Corp., 200 Varick St., New York 14, N. Y. ALgonquin 5-5400

Alpitec, Inc., 49 Gleason Ave., Stamford, Conn. FIreside 8-7788

Altair, Inc., Hillside Ave., Terryville, Conn. LUdlow 3-1343

Altenoder & Sons, Theo., 1217 Spring Garden St., Philadelphia 23, Pa. POplar 5-3180
(See advertisement on page 141)

Alto Scientific Co., 855 Commercial St., Palo Alto, Calif. DAvenport 1-3434

Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa. ATlantic 1-4545

Amatom Electronic Hardware Co., Inc., 88 Drake Ave. New Rochelle, N. Y. BEverly 5-4441

Amco Engineering Co., 7333 W. Ainslie St., Chicago 31, Ill. UNderhill 7-8500
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Amelco, Inc., 2040 Colorado Ave., Santa Monica, Calif. EX 3-7281

Amerac, Inc., Dunham Road, Beverly, Mass. WAlker 2-8611

Amerelay Corp., 130 County Courthouse Rd., New Hyde Park, N. Y. PIoneer 7-2150

American Balance Corp., 48 Potter Ave., New Rochelle, N. Y. NE 6-8080

American Cystoscope Makers, Inc., 8 Pelham Parkway, Pelham Manor (Pelham), N. Y. PElham 8-4900

American Data Div., American Electronics, Inc., 75 Front St., Brooklyn, N. Y. ULster 8-0500

American Electronic Laboratories, Inc., 121 N. 7th St., Philadelphia 6, Pa., WA 5-8780

American Electronics, Inc., 1625 W. 7th St., Los Angeles 17, Calif.

American Felt Co., Glenville, Conn., JEfferson 1-8700
American Gas Furnace Co., 140 Spring St., Elizabeth, N. J. EL-2-2120

American Kloeckner-Moeller Corp., 4113 E. 11th St. Tulsa 12, Okla. WEbster 6-3048

American Laubscher Corp., 230 W. 57th St., New York 19, N. Y. JUdson 6-7474
(See advertisement on page 167)

American Measurement & Control, 240 Calvary, Waltham 54, Mass. TWinbrook 4-6212

American Meter Co., 13500 Philmont Ave., Philadelphia 16, Pa. ORchard 3-2100

Albany Representative
96 South Swan Street
Albany, N. Y.
Albany 4-9760

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Atlanta 5, Ga.
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Birmingham 3, Ala.
Alpine 1-8361

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HUbbard 2-8558

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Capitol 2-9051

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New York 17, N. Y.
Murray Hill 7-8980

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San Francisco 11, Calif.
Garfield 1-5975

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Tulsa 1, Oklahoma
Luther 3-5163

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American Super Temperature Wires, Inc., 36 W. Canal St., Winooski, Vt. UNiversity 2-9636

American Thermo Electric Co., 1023 N. Fuller Ave., Los Angeles 46, Calif. HOllywood 4-1632
(See advertisement on page 183)

American Thermo-Ware Co., 12-16 Warren St., New York 7, N. Y.

American Time Products, 580-5th Ave., New York 36, N. Y. PLaza 7-1430

Amglo Corp., 4333 N. Ravenswood Ave., Chicago 13, Ill. BUckingham 1-2727
(See advertisement on pages 61, 168, 171)

Ampco Mfg. Co., 246 E. 2nd St., Plainfield N. J. PLainfield 7-4600

Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y. Wells 1-6200

Amperite Co., Inc., 561 Broadway, New York 12, N. Y.
(See advertisement on page 173)

Ampex Corp. Instrumentation Div., 934 Charter St., Redwood City, Calif. EMerson 9-1481

Amphenol Connector Div., Amphenol-Borg Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.
Authorized Distributor
Schweber Electronics
60 Herricks Rd., Mineola, L. I., N. Y.
PIoneer 6-6520

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y. WOrth 6-2929

Amther Testing Instrument Co. Inc., 45-53 Van Sinderen Ave., Brooklyn 7, N. Y. Dickens 6-8841
(See advertisement on page 139)

Anadex Instruments, Inc., 14734 Arminta St., Van Nuys, Calif. STate 0-7911

Analogue Controls, Inc., 200 Frank Road, Hicksville, N. Y. OVerbrook 1-7300

Analytic Systems Co., 980 Fair Oaks Ave., Pasadena Calif. RYan 1-6634

Analytical Measurements, Inc., 585 Main St., Chatham, N. J. MErcury 5-7474

Andersen Laboratories, Inc., 501 New Park Avenue, West Hartford, Conn. AD-3-4491

Andromeda, Inc., 3742 Howard Ave., Kensington, Md. LOckwood 5-3775

Annin Company, 1040 So. Vail Ave., Montebello, Calif. RAymond 3-9351

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Applied Instruments, Inc., 25 Will Place, Brooklyn 7, N. Y. CLoverdale 7-0885

Applied Physics Corp., 2724 So. Peck Road, Monrovia, Calif. HIllcrest 6-7181

Applied Radiation Corp., 2404 No. Main St., Walnut Creek, Calif. YEllowstone 5-2250

Applied Research Laboratories, Inc., P.O. Box 1710, Glendale, Calif. CHapman 5-5524

Applied Science Corp. of Princeton, Princeton, N. J. SW-9-1000

Arenberg Ultrasonic Laboratory, Inc., 94 Green St., Jamaica Plain 30, Mass. JAmaica 2-8640

Arens Controls, Inc., 2017 Greenleaf St., Evanston, Ill. DA 8-4700
(See advertisement on page 158)

Aristo Grid Lamp Products, Inc., 65 Harbor Road, Port Washington, L. I., N. Y. PO-7-6577
(See advertisement on page 122)

Arkwin Industries Inc., 648 Main St., Westbury, L. I., N. Y. EDgewood 3-2640

Arma Division, American Bosch Arma, Roosevelt Field, Garden City, N. Y. PIoneer 2-2000

Arnold Engineering Co., P. O. Box G, Marengo, Ill. Chicago ANdover 3-6300

Arnoux Corp., 11924 W. Washington Blvd., Los Angeles 66, Calif. TExas 0-5371

Artisan Metal Works Co., 11400 Madison Ave., Cleveland 2, Ohio. LAkewood 1-6173

Assembly Products, Inc., 75 Wilson Mills Road, Chesterland, Ohio. HAmilton 3-4436 (Cleveland)

Associated Control Equip., Inc., P.O. Box 136, Coraopolis, Pa. AMherst 4-8161

Associated Research, Inc., 3789 W. Belmont Ave., Chicago 18, Ill. COrnelia 7-4040
(See advertisement on page 104)

Associated Specialties Co., 1751 Main St., Orefield, Pa. EX-5-1275
(See advertisement on page 110)

Associated Spring Corp., Bristol, Conn. LUdlow 3-1331

Associated Testing Laboratories, Inc., 117 Clinton Rd., Caldwell, N. J. CApital 6-7407

Associated Valve Co., W. Walnut St., North Wales, Pa. OXbow 9-4485

Astra Technical Instrument Corp., 1132 Mission St., So. Pasadena, Calif. Ryan 1-2114

Atkins Technical Inc., 1276 W. 3rd St., Cleveland 13, Ohio SUperior 1-1333
(See advertisement on page 66)

Atlantic Research Corp., Shirley Highway at Edsall Rd., Alexandria, Va. FLeetwood 4-3400

Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago 13, Ill.

Atlas Engineering Co., Inc., 176 Blue Hill Ave., Roxbury, Mass. HI-5-7100

Atlas Valve Co., 280 South St., Newark 5, N. J.

Atocon Corp., 527 N. Union St., Galion, Ohio

Atronic Products, Inc., 1 Bala Ave., Bala-Cynwyd, Pa. GReenwood 7-1860

Auburn Mfg. Co., 50 Stack St., Middletown, Conn. DIamond 6-6631

Audio Development Co., 2833-13th Ave. So., Minneapolis 7, Minn. PArkway 9-7386

Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y. PLaza 1-6640

Audio Instrument Co., Inc., 185 W. 14th St., New York 11, N. Y. ORegon 5-7820

Autoclave Engineers Sales Corp., 2930 W. 22nd St., Erie, Pa. TE 8-2071

Auto-Control Laboratories, Inc., 333 S. Hindry Ave., Inglewood 1, Calif. OR-8-4934

Automark Marking Equipment Co., 1920 So. Vandeventer Ave., St. Louis 10, Mo. PRospect 3-0567

Automatic Electric Sales Co., Northlake, Illinois. FIlmore 5-7111

Automatic Metal Products Corp., 323 Berry St., Brooklyn 11, N. Y. EV-8-6057

Automatic Scale Co., Inc., 180 Lafayette St., New York 13, N. Y. CAnal 6-7676

Automatic Switch Co., 50-56 Hanover Rd., Florham Park, N. J. FRontier 7-4600
(See advertisement on page 73)

Automatic Timing & Controls Inc., 201 Old Gulph Road, King of Prussia, Penna. BRoadway 9-1180
(See advertisement on pages 31, 69, 112, 183)

Automatic Valve Co., 37415 Grand River, Farmington, Mich. GR-4-6700

Automation Controls Corp., 5737 W. 98th St., Los Angeles 45, Calif. SPring 6-0420

Automation Products, Inc., 3030 Maxroy, Houston 24, Tex. UN-9-1485

Autonetics, Div. of No. American Aviation, Inc., 9150 E. Imperial Hwy., Downey, Calif. SPruce 3-2233

Autotron, Inc., 3629 N. Vermilion St., Danville, Ill. HIckory 6-0650
Representative
John T. Fuhrman, Jr.
6822 Thomas Blvd., Pittsburgh 8, Pa.
MOntrose 1-3838

Autotronics, Inc., P.O. Box 208, Florissant, Mo. TEmple 7-3565

Avco Corp., Research & Advanced Dev., 201 Lowell St., Wilmington, Mass. OLiver 8-8911. X2700

Avionic Supply, 5790 Washington Blvd., Culver City, Calif. WEbster 3-8523

Axler Associates, Inc., 102-42-43rd Ave., Corona 68, N. Y. HAvemeyer 9-7719
(See advertisement on page 123)

B

B. & B. Electric Motor Co., 206 Lafayette St., New York 12, N. Y. WO-6-5777

B & F Instruments, Inc., 3644 N. Lawrence St., Philadelphia 40, Pa. GArfield 5-4175
Rep—E. Pa., S.N.J., Dela., Md., D. C., Va.
Polymetric Devices Co., Inc.
P.O. Box 236, Glenside, Pa. TU-7-4873
P.O. Box 246, Silver Spring, Md.

B & H Instrument Co., Inc., 3479 West Vickey Blvd., Fort Worth, Texas
(See advertisement on page 113)

B-I-F Industries, Inc., 345 Harris Ave., Providence 1, R.I. GAspee 1-4302

BJ Electronics, Borg-Warner, 3300 Newport Blvd., Santa Ana, Calif. KI-55581

B/W Controller Corp., 220 E. Maple, Birmingham, Mich. MI 4-5940

Bacharach Industrial Instrument Co., 200 N. Braddock Ave., Pittsburgh 8, Pa. CHurchill 2-5400
(See advertisement on page 67)

Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y. WAtkins 1-2121
(See advertisement on page 189)

Bacon Industries, Inc., 192 Pleasant St., Watertown 72, Mass. WAtertown 4-5000

Badger Meter Mfg. Co., 4545 W. Brown Deer Road, Milwaukee 18, Wis. FLagstone 5-0400

Bailey Co., Chas. M., 667 Folsom St., San Francisco 7, Calif. EXbrook 7-1611

Bailey Meter Co., 1041 Ivanhoe Rd., Cleveland 10, Ohio. GL-1-4600
(See advertisement on pages 30, 31, 36, 38, 40, 46, 50, 57, 58, 67, 74, 79, 162, 171, 173, 174, 184

Baird-Atomic, Inc., 33 University Rd., Cambridge 38, Mass. UNiversity 4-7420
(See advertisement on pages 32, 86)

New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Baker Company, Inc., 106 Granite St., Biddeford, Me. Telephone 4-8441

Balco Research Laboratories, Capacitor Div., 49-53 Edison Pl., Newark 2, N. J. MI-3-5200

Bald Eagle Corp., 356 Cedar St., St. Paul 1, Minn. CA-2-7257

Baldwin-Lima-Hamilton Corp., Electronics & Instrumentation Div., 42-4th Ave., Waltham 54, Mass. TWinbrook 4-6700

Barber Colman Co., 1700 Rock St., Rockford, Ill. WO-86633 Electrical Components Div., Small Motors Div., 1300 Rock St., Rockford, Ill.

Barden Corp., Danbury, Conn. PIoneer 3-3885

Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif. LUdlow 9-6181

Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn. FIreside 8-5381

Barnstead Still & Demineralizer Co., 244 Lanesville Terrace, Boston 31, Mass. JA-4-3100

Barton Instrument Corp., 580 Monterey Pass Rd., Monterey Park, Calif. CUmberland 36501
(See advertisement on page 199)

Basler Electric Co., Route 143, P.O. Box 269, Highland, Ill. Telephone 2123

Baso Inc., 730 N. Jackson St., Milwaukee 1, Wis. Broadway 3-5388

Bausch & Lomb Optical Co., 738 St. Paul St., Rochester 2, N. Y. LOcust 2-3000

Bayley Instrument Co., Box 538, Danville, Calif. VE-7-4649
(See advertisement on page 199)

Temperature Controllers
± .01° C & ± .001° C
Ranges: — 200° C to + 500° C
Write for literature
BAYLEY INSTRUMENT CO.
Box 538 Danville, Calif.

CIRCLE 377 ON READER-SERVICE CARD

Bear Manufacturing Co., Industrial Div., 2016-5th Ave., Rock Island, Ill. Telephone 6-6461

Beaver Gear Works, Inc., 1025 Parmele St., Rockford, Ill. WOodland 3-9691

Becker Brothers Carbon Co., 3450 So. Laramie Ave., Cicero 50, Ill. BIshop 2-1260

Beckman Instruments Inc., Berkeley Div., 2200 Wright Ave., Richmond Calif. LA-6-7750

Beckman Instruments, Inc., Helipot Div., 2500 Fullerton Rd., Fullerton, Calif. TRojan 1-4848

Beckman Instruments, Inc., Scientific & Process Instrs. Div., 2500 Fullerton Rd., Fullerton Calif. OWen 7-1771

Beckman Instruments, Inc., Spinco Div., 1117 California Ave., Palo Alto Calif. DAvenport 6-1970

Beede Electrical Instrument Co., Inc., So. Main St., Penacook, New Hampshire. PLaza 3-6362

Behlman Engineering Co., 2911 Winona Ave., Burbank, Calif. Victoria 9-5733
(See advertisement on page 110)

Bel-Art Products, Pequannock, N. J., OXbow 4-0500

Belfab Corp., 382 Walnut St., Agawam, Mass. RE-7-1277
Representative
Mitchell B. Halsten
The M. B. Halsten Company
P.O. Box 848, Burbank, Calif.

Bellmore Gear Div. (see Empire State Laboratories)

Bellofram Corp., Blanchard Rd., Burlington Mass. Browning 2-2100

Bemco Inc., 11631 Vanowen St., No. Hollywood Calif.

Bendix Computer Div., Bendix Aviation Corp., 5630 Arbor Vitae St., Los Angeles 45, Calif. SPring 6-2220

Bendix Aviation Corp., Cincinnati Div., 3130 Wasson Road, Cincinnati 8, Ohio. ELmhurst 1-2323

Bendix Aviation Corp., Montrose Div., So. Montrose, Pa. Montrose 570

Bendix Aviation Corp., Pioneer Central Div., Hickory Grove Rd., Davenport, Iowa Telephone 7-9101

Bendix Aviation Corp., Scintilla Div., Sidney, N. Y. LOwell 3-9511

BARTON INSTRUMENT CORPORATION SALES REPRESENTATION

NORTH AMERICA

United States of America

Amarillo, Texas	SNYDER COMPANY, INC., 3615 S. Lipscomb St.	FL 6-5471
Anna Maria, Florida	GULF INSTRUMENT ASSOCIATES, P. O. Box 402	9-6621
Atlanta 13, Georgia	HAYDEN ENGINEERING SALES CO., 222 14th St., N.W.	TR 4-4291
Baltimore 18, Maryland	GEORGE GOODMAN COMPANY, 103 E. 25th St.	BE 5-5570
Birmingham 9, Alabama	HAYDEN ENGINEERING SALES CO., 210 Hollywood Blvd.	TR 1-0637
Boston 16, Massachusetts	*CARR BROTHERS COMPANY, 258 Park Square Building	LI 2-1326
Buffalo, New York	M. S. JACOBS & ASSOCIATES, 1807 Elmwood Ave.	DE 3229
Charleston 30, W. Virginia	PROCESS INSTRUMENTS & EQUIPMENT CO., 1904 Washington Ave.	DI 2-2151
Charlotte, N. Carolina	MACGUIRE INSTRUMENT CO., 3214 Highview Road	EM 6-3454
Chicago 46, Illinois	NIELSEN & FRYER, INC., 5717 N. Elston Ave.	NE 1-1824
Cincinnati 8, Ohio	THE ABBOTT COMPANY, 3437 Michigan Ave.	EA 1-2349
Cleveland 7, Ohio	T. I. EQUIPMENT CO., 15017 Detroit Ave.	AC 6-1970
Columbus 1, Ohio	THE ABBOTT COMPANY, 1324 Highland St.	AX 9-4244
Corpus Christi, Texas	SNYDER COMPANY, INC., 1409 Ocean Drive	TU 4-8581
Dallas, Texas	SNYDER COMPANY, INC., 6234 Peeler Ave.	FL 2-0760
Dayton, Ohio	THE ABBOTT COMPANY, 407 Realty Building	BA 8-7203
Denver 11, Colorado	*PROCESS EQUIPMENT CO., 2548 W. 29th Ave.	GL 5-4766
Detroit, Michigan	INDUSTRIAL INSTRUMENT SUPPLY & MFG. CO., 14222 Robson Ave.	VE 8-5940
Englewood, New Jersey	BLAKE EQUIPMENT CORP., 409 Grand Avenue	LO 7-4252
Farmington, New Mexico	SNYDER COMPANY, INC., 1903 E. Mojave St.	DA 5-6972
Glens Falls, New York	O. R. LAWRENCE CO., Room 411, 21 Bay Street	2-4528
Hartford, Connecticut	CARR BROTHERS COMPANY, 119 Ann Street	CH 7-0395
Houston 24, Texas	*SNYDER COMPANY, INC., 5701 Washington Ave.	UN 1-6116
Kansas City 12, Missouri	POWER SPECIALTIES CO., 1214 W. 47th St.	JE 1-6550
Lafayette, Louisiana	OIL & GAS SPECIALTIES CO., P. O. Box 1424	CE 5-4444
Louisville, Kentucky	THE ABBOTT COMPANY, 366 Francis Building	JU 4-4713
Marietta, Ohio	PROCESS INSTRUMENTS & EQUIPMENT CO., 110 Knox St.	FR 4-6767
Memphis 12, Tennessee	ENGINEERED INSTRUMENT SALES CO., 2717 Union Ave.	FA 3-1275
Minneapolis 9, Minnesota	ENGINEERED SALES CO., 314 W. 38th St.	TA 4-0696
Monterey Park, California	BARTON SALES COMPANY, 350 S. Atlantic Blvd.	AT 9-3549
New Orleans 12, Louisiana	OIL & GAS SPECIALTIES CO., P. O. Box 10246	FO 1-9914
New York City, New York	BLAKE INSTRUMENT CORP., 409 Grand Ave., Englewood, New Jersey	LO 4-4815
Odessa, Texas	*SNYDER COMPANY, INC., 709 West County Road	FE 2-9408
Phoenix, Arizona	CONE & WALLACE CO., 1325 S. 26th St.	BR 5-4496
Philadelphia 40, Penn.	TEST EQUIPMENT SALES CO., 4447 N. Bodine St.	DA 9-1822
Pittsburgh 5, Penn.	M. S. JACOBS & ASSOCIATES, 810 Noblestown Road	WA 1-6140
Portland 1, Oregon	FRYER AND CO., INC., 2035 S. W. 58th Ave.	CA 6-3733
Salt Lake City, Utah	PROCESS EQUIPMENT CO., Suite 212, 29 E. 2nd S.	EL 5-9124
San Francisco 11, Calif.	BELILOVE COMPANY, 420 Market St.	YU 2-3713
St. Louis 22, Missouri	E. B. MILLER CO., 10117 Manchester Road	YO 6-8250
N. Syracuse, New York	O. R. LAWRENCE CO., 204 S. Main St.	GL 8-0910
Tulsa 20, Oklahoma	SNYDER COMPANY, INC., 1432 E. Sixth St.	GI 7-0126

Canada

Calgary, Alberta	*PRECISION OILFIELD SERVICES, LTD., 121 14th St.	AT 3-1650
Edmonton, Alberta	*PRECISION OILFIELD SERVICES, LTD., 7718 104th St.	3-7992
Estevan, Saskatchewan	*PRECISION OILFIELD SERVICES, LTD., P. O. Box 1033	4-2102
Lancaster, New Brunswick	K & A ENGINEERING CO., 30 O'Brien St.	OX 4-6120
Montreal, Quebec	JOHN PREFONTAINE, 359 Kensington Ave.	WE 7-4341
Sillery, Quebec	CHALEUR, INC., 1453 Pine Ave.	LA 7-1945
Toronto 5, Ontario	*BAKER INSTRUMENTS, LTD., 185 Davenport Rd.	WA 4-9708
Vancouver 4, B.C.	JOHN SHERMAN, 855 E. Hastings St.	MU 4-9109
Winnipeg, Manitoba	MACKAY-MORTON, LTD., 183 James Ave., East	WH 2-7231

Cuba

Havana	GUILLERMO E. OCHOA, San Lazaro 16	A 4873

Mexico

Mexico 19, D.F.	VICAL, S.A., Miguel Angel 96-98	24-31-34

SOUTH AMERICA

Anaco, Venezuela	*A-Z EXPORT, S.A.	
Buenos Aires, Argentina	KENNETH J. LANGLEY, Corrientes 1115	35-1842
La Paz, Bolivia	OIL INDUSTRY SUPPLY & SERVICE CO., Casilla 1268	3917
Las Maroches, Venezuela	*A-Z EXPORT, S.A.	
Maracibo, Venezuela	*A-Z EXPORT, S.A., Apartado 304, Hotel Del Largo	6892
Puerto La Cruz, Venezuela	*A-Z EXPORT, S.A., Apartado 4026	MG 086-332
Rio de Janeiro, Brazil	H. V. LAGE, Rua Mexico 45	42-8368
Talara, Peru	OILFIELD IMPORT, S.A., Apartado 71	

AFRICA

Transvaal

Elandsfontein Rail	NEGRETTI & ZAMBRA, LTD., Bell's Circle	58-2184/9
Johannesburg	NEGRETTI & ZAMBRA, LTD., Maritime House, P. O. Box 4378	23-1974/5

EUROPE & ASIA

Copenhagen V, Denmark	KRAGH-MULLER & ANDERSEN, H. C. Andersens Blvd. 4	
Genova, Italy	G. CASTELLAZO, Lungobisagno Istria 34	83318-876,873
The Hague, Holland	**BARTON-EUROPA, Zonweg 41	779874
Harlow, Essex, England	**SUNVIC CONTROLS, LTD., P. O. Box 1, Stone Cross	25271
London, W.C.2, England	SUNVIC CONTROLS, LTD., Crown House, Aldwych	Temple Bar 8040
Milano, Italy	FABBRICHE ELETTROTENICHE RIUNITE, SPA, Via Canova N. 12	346851
Minden-Westfalen, Germany	**SCHOPPE & FAESER, G.M.B.H., Schillerstr. 72	Fernrufsammelnur 3631
Paris 18e, France	PROMESUR, 19 Rue Eugene Carriere	ORN 37-89
Stockholm, Sweden	A. B. KIHLSTROMS MANOMETERFABRIK, Malmsgardsvagen 63	23-22-05
Tokyo, Japan	**HOKUSHIN ELECTRIC WORKS, LTD., 312 Shimomaruko-Cho, Ota-ku	Kamata (73)-2241

*Operate Repair Stations.
**Operate Repair Stations, and are licensed to manufacture.

BARTON INSTRUMENT CORPORATION | 580 MONTEREY PASS ROAD | MONTEREY PARK, CALIFORNIA

CIRCLE 378 ON READER-SERVICE CARD

Bendix Aviation Corp., Utica Div., 211 Seward Ave., Utica N. Y. SWift 7-2500

Bergen Labs., Inc., 247 Crooks Ave., Clifton N. J. GR 3-7800

Berger & Sons, Inc., C. L., 37 Williams St., Boston 19, Mass. HIghland 5-1870

Berkeley Dynamics, 2831-7th St., Berkeley 10, Calif. TH-3-2788 or TH-8-0382

Berkshire Laboratories, 582 Bank Village, Greenville, N. H. Greenville 111

Berneo Engineering Corp., 2320 So. Tibbs Ave., Indianapolis 41, Ind. CHapel 1-2871

Beva Laboratory, Inc., P.O. Box 478, Trenton 9, N. J. EXport 4-4074

Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
(See advertisement on pages 62, 103, 104, 105)

Biggs Co., Carl H., 1547-14th St., Santa Monica, Calif. GRanite 80461

Bio-Dicator Co., 13946 Kercheval, Detroit 15, Mich. VA 2-6952
(See advertisement on page 60)

Biophysical Electronics, Inc., 20 Herman St., Philadelphia 44, Pa. GErmantown 8-5260

Bird & Co., Inc., Richard H., 1 Spruce St., Waltham 54, Mass.
(See advertisement on page 152, 161)

Bishop & Co., J., Platinum Works, E. King St., Malvern, Pa. NIagara 4-3100

Black, Sivalls & Bryson, Inc., Controls Div., 302 N. Cincinnati, Tulsa, Okla. GIbson 7-8441

Blickman, Inc., S., 516 Gregory Ave., Weehawken, N. J.

Bliley Electric Co., 200 Union Station Bldg., Erie, Pa.

Blue M Electric Co., 138th & Chatham St., Blue Island Ill. FUlton 5-9000

Bock Machine Co., 2950 Jonrose Ave., Cincinnati 39, Ohio. JA-2-1171

Bodine Electric Co., 2500 W. Bradley Place, Chicago 18, Ill. IRving 8-3515

Boehm Co., R. A., 58 Brooklyn Ave., Merrick, N. Y.

Boehme, Inc., H. O., 915 Broadway, New York 10, N. Y. SPring 7-2208

Bogart Manufacturing Corp., 315 Seigel St., Brooklyn 6, N. Y. HY-7-4972

Boone Instrument Co., 130 E. 7th St., New York 9, N. Y. ORegon 7-6986

Boonton Electronics Corp., 738 Speedwell Ave., Morris Plains, N. J.

Borden Chemical Co., Resinite Dept., P.O. Box 1589, Santa Barbara, Calif. WOodland 3134

Borg Equipment Div., Amphenol-Borg Electronics Corp., 120 So. Main St., Janesville, Wis. PL-4-6616
(See advertisement on page 148)

Boston Gear Works, Quincy 71, Mass. PR-3-0400

Boulin Instrument Corp., 10 First St., North Palham, N. Y.
(See advertisement on page 62)

Bourns, Inc., P.O. Box 2112, Riverside, Calif. OVerland 4-1700
Authorized Factory Source
Schweber Electronics
60 Herricks Rd., Mineola, L. I., N. Y.
PIoneer 6-6520

Bowen Corp., 11 University Rd., Cambridge 38, Mass. UNiversity 4-6170

Bowmar Instrument Corp., 8000 Bluffton Rd., Fort Wayne, Ind. SHerwood 3121

Bowser Inc., 1302 E Creighton Ave., Ft. Wayne 2, Ind. H-2341

Brabender Corp., 244 Saddle River Rd., Rochelle Park, N. J. HUbbard 7-0214-5

Brabender Instruments Inc., C. W., 50 E. Wesley St., South Hackensack, N. J. DIamond 3-8425

Brach Manufacturing Corp., 200 Central Ave., Newark 3, N. J. HUmboldt 2-1500

Bracke-Seib X-Ray Co., Inc., 16 Pelham Bay Park West, Pelham Manor, N. Y. PElham 8-4346

Brainin Co., C. S., 320 Washington St., Mt. Vernon, N. Y. MO-8-5500
(See advertisement on page 159)

Brand & Co., Inc., Wm., 47 North St., Willimantic, Conn. HArrison 3-6301

Branson Instruments, Inc., 37 Brown House Rd., Stamford Conn. DAvis 4-6721

Branson Ultrasonic Corp., 37 Brown House Rd., Stamford, Conn. Fireside 8-7781
(See advertisement on page 112)

Breeze Corporations Inc., 700 Liberty Ave., Union, N. J.

Brew & Co., Richard D., 90 Airport Rd., Concord, N. H. CApitol 5-6606

Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., 155 Hill St., Milford, Conn. TRinity 8-1721
(See advertisement on pages 149, 150)

Brinkmann & Co., C. A., Inc., 115 Cutter Mill Road, Great Neck, L. I., N. Y.

Bristol Co., Waterbury 20, Conn. PLaza 6-4451
(See advertisement on pages 31, 39, 41, 46, 57, 65)

Bristol Brass Corp., 580 Broad St., Bristol, Conn. LUdlow 2-3161

British Industries Corp., Div. of Special Instruments, 80 Shore Rd., Port Washington, N. Y. PO-7-7700
(See advertisement on page 170)

Bronoptics Co., 1665 Oak Knoll Ave., San Marino, Calif. SY-9-1022

Brookfield Engineering Labs., Inc., 240 Cushing St., Stoughton, Mass. FIeldbrook 4-4310

Brooks Rotameter Co., 407 W. Vine St., Hatfield, Pa. ULysses 5-5174
Pittsburgh Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa.
WAlnut 1-6140

Brunswick Instruments, P. O. Box 813, New Brunswick, N. J. CHarter 7-5919

Brush Instruments Div., Clevite Corp., 37th & Perkins, Cleveland 14, Ohio. ENdicott 1-3315
(See advertisement on pages 82, 83)

Bryant Computer Products Div., Clinton St., Springfield, Vt. TUrner 5-2141

SALES OFFICES

General Office
Bryant Computer Products Division
P.O. Box 620, Springfield, Vermont
Telephone: TUrner 5-2141
F. L. Smith, Sales Manager

Chicago
Bryant Computer Products Division
5454 West Higgins Avenue
Chicago 30, Illinois
Telephone: KIldare 5-3228
Ray Ramon

Los Angeles
Bryant Computer Products Division
12200 South Bellflower Boulevard
Downey, California
Telephone: TOpaz 1-9258
Tim Foley

Sales Representatives

Roslyn, Long Island, New York
Mr. John Wilds, Wild & Associates, Inc.
1519 Northern Boulevard
Telephone: MAyfair 1-8660

La Canada, California
Mr. H. W. Ruby, R & D., Inc.
P.O. Box 308
Telephone: MUrray 1-5845

Buchanan Electrical Products Corp., 504 U. S. 22, Hillside N. J. WAverly 3-7474

Bud Radio, Inc., 2118 East 55th St., Cleveland 3, Ohio HEnderson 1-7166
(See advertisement on page 156)

Budd Stanley Co., Inc., 43-01-22nd St., Long Island City, N. Y. STillwell 6-1706

Buffalo Meter Co., 2906 Main St., Buffalo, New York
(See advertisement on page 36)

BUFFALO METER REPRESENTATIVES

Albany 5, New York
Energy Control Co., Inc.
1203 Central Avenue
Phone: Albany 2-2938

Amarillo, Texas
Snyder Company, Inc.
3615 S. Lipscomb
Phone: FL-6-5471

Altanta 24, Georgia
Boiler Equipment Service Co.
P.O. Box 13138
Phone: Melrose 4-7373

Baltimore 18, Maryland
H. P. Rodgers
100 W. 25th Street
Phone: Liberty 2-2122, 2-9919

Birmingham 9, Alabama
Hayden Engineering Sales Co.
210 Hollywood Blvd.
Phone: Tremont 1-0637

Burlingame, California
T. R. Routh Co.
1209 Capuchino Ave.
Phone: Diamond 2-4147

Boston 10, Massachusetts
Control Instruments, Inc.
55 Batterymarch St.
Phone: Hancock 6-6416

Charleston 24, West Virginia
Engineering Products Co.
P.O. Box 1107
Phone: Dickens 3-9411

Charlotte 1, North Carolina
Mec-Tric Control Co.
P. O. Box 209
Phone: Franklin 6-8531

Chicago 10, Illinois
Meters and Controls, Inc.
444 N. LaSalle Street
Phone: Whitehall 4-1448

Cinncinnati 37, Ohio
Chapman Engineering Sales Co.
1717 Section Road
Phone: Elmhurst 1-3140

Cleveland 23, Ohio
Illes Power Control Co.
22700 Shore Center Drive
Phone: Redwood 2-9300

Dallas 35, Texas
Snyder Company, Inc.
6234 Peeler Street
Phone: Fleetwood 2-0760

Denver 5, Colorado
Joy and Cox, Inc.
2124 Broadway
Phone: Amherst 6-0323

Des Moines 9, Iowa
Deco Engineering Products
1112 Locust Street
Phone: Atlantic 8-5721

Detroit 12, Michigan
Metrol Company
7145 E. Davidson
Phone: Twinbrook 3-6300

El Paso, Texas
Steel and Engineering Prod. Co.
P.O. Box 3626
Phone: 3-5521

Honolulu 17, Hawaii
H. S. Gray Co.
P.O. Box 3016

Houston 24, Texas
Snyder Company, Inc.
P.O. Box 19134
Phone: Underwood 1-6116

Indianapolis 4, Indiana
DeHaven Engineering Co.
1444 Consolidated Bldg.
115 North Penn Street
Phone: Melrose 2-2563

Kalamazoo, Michigan
Metrol Company
420 W. South Street
Phone: Fireside 2-6097

Kansas City 14, Missouri
Economy Equipment Company
7341 Broadway
Phone: Jackson 3-1010

Knoxville 5, Tennessee
Leinart Engineering Company
412 Fifth Avenue, N. E.
Phone: 5-0363

Los Angeles 22, California
W. R. Ladewig Co.
5608 E. Washington Blvd.
Phone: Raymond 3-6371

Louisville 16, Kentucky
Control Products Company
P. O. Box 56
Phone: Juniper 4-4900

Memphis 6, Tennessee
Process and Power Inc.
P.O. Box 10138
Phone: Whitehall 5-3253

Milwaukee 4, Wisconsin
Geo. H. Fredricks & Co., Inc.
4385 N. Green Bay Avenue
Phone: Concord 4-1070

Minneapolis 2, Minnesota
Power Process Equip., Inc.
746 Builders Exchange Building
Phone: Federal 2-8861

New Orleans 19, Louisiana
Frieshon & Belsom
P.O. Box 7044
Phone: Vernon 5-3165

New York 38, New York
Energy Control Co., Inc.
5 Beekman Street
Phone: Barclay 7-0457

North Haven, Connecticut
Energy Control Co., Inc.
2 Linsley Street
Phone: Cedar 9-2513

Odessa, Texas
Snyder Company, Inc.
709 West County Road
Phone: Federal 2-4802

Philadelphia, Pennsylvania
Flow Engineering, Inc.
P.O. Box 476
Flourtown Pennsylvania
Phone: Chestnut Hill 8-1355

Pittsburgh 5, Pennsylvania
M. S. Jacobs & Associates, Inc.
810 Noblestown Road
Phone: Walnut 1-6140

Richmond 20, Virginia
Berkness Control & Equipment Corp.
308 W. Cary St.
Phone: Milton 3-5357

St. Louis 8, Missouri
Economy Equipment Company
4526 Olive Street
Phone: Forest 7-5328

Salt Lake City, Utah
Joy and Cox, Inc.
415 Judge Building
Phone: Empire 3-2769

Santurce 1, Puerto Rico
Ramon I. Gil
P.O. Box 9182, Santurce Station

Seattle 4, Washington
The Burhans-Sharpe Company
1743 First Avenue S.
Phone: Main 9006

Tulsa 20, Oklahoma
Snyder Company, Inc.
1432 East Sixth Street
Phone: Gibson 7-0126

Buff & Buff Mfg Co., 329 Lamartine St., Jamaica Plain, Mass. JAmaica 4-1770
(See advertisement on page 201)

SURVEYING INSTRUMENTS
and accessories
BUFF AND BUFF MFG. CO.
329 Lamartine St.
Jamaica Plain 30, Mass.

CIRCLE 379 ON READER-SERVICE CARD

Buhl Optical Co., 1009 Beech Ave., Pittsburgh 33, Pa. FAirfax 1-0076

Bulova Research & Development Labs., Inc., 62-10 Woodside Ave., Woodside 77, N. Y. NEwtown 9-5700

Bulow Electric Co., 11000 Capital Ave., Oak Park 37, Mich. LI 7-1133

Bureau of Engraving Inc., Industrial Div., 500 So. 4th St., Minneapolis 15, Minn. FE-9-8721

Burgess Battery Co., Div. of Servel, Inc., Foot of Exchange, Freeport, Ill. AD-2-2161
(See advertisement on page 153)

Burke & James, Inc., 321 So. Wabash Ave., Chicago 4, Ill. HArrison 7-8393

Burling Instrument Co., 18 River Rd., Chatham, N. J. MErcury 5-9481
(See advertisement on page 63)

Burndy Corp., Omaton Div., Richards Ave., Norwalk, Conn. TEmple 8-4711

Burnell & Co., Inc., 10 Pelham Parkway, Pelham Manor, N. Y. PE-8-5000

Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa. GRant 1-2527

Burroughs Corp., 6071 Second Ave., Detroit 2, Mich. TR-5-2260

Burroughs Corp., Electronic Tube Div., P. O. Box 1226, Plainfield, N. J. PL 6-0876
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Burton Mfg. Co., 2520 Colorado Ave., Santa Monica, Calif. TExas 0-7561

Burton-Rogers Co., Sales Div., Hoyt Electrical Instrument Works, 42 Carleton St., Cambridge 42, Mass. EL-4-1643

Bush Associates, G. F., Box 175, Princeton, N. J.

Bushnell & Co., D. P., Bushnell Bldg., Pasadena, Calif. RYan 1-8143

Bussmann Manufacturing Div., McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo. GAfriel 1-1740

Bytrex Corp., 50 Hunt St., Newton 58, Mass. WA-6-6380
(See advertisement on page 60)

C

CBS Electronics, 100 Endicott St., Danvers, Mass. SPring 4-2360

CGS Laboratories, Inc., Routes 7 and 35, Ridgefield, Conn. IDlewood 8-6571

CDC Control Services, Inc., 400 S. Warminster Rd., Hatboro, Penna.

C & K Components, Inc., 101 Morse St., Newton 58, Mass. WAtertown 3-0524

Caddell-Burns Mfg. Co., Inc., 40 E. 2nd St., Mineola, N. Y. PIoneer 6-2310

Cahn Instrument Co., 14511 Paramount Blvd., Paramount, Cal. NE 69456 (Los Angeles)

Caig Laboratories, 46 Stanwood Road, New Hyde Park, L. I., N. Y. PIoneer 2-0278

California Chassis Co., 5445 E. Century Blvd., Lynwood, Calif. NEvada 6-9931

California Magnetic Control Corp., 11922 Valerio St., No. Hollywood, Calif. STanley 7-1104

Calif. Technical Indus. Div. of Textron, Inc., 1421 Old County Road, Belmont, Calif. LYtell 3-8466

Calumet Engineering Co., 2246 Calumet Ave., Chicago 16, Ill. DAnube 6-6858

Cambridge Instrument Co., Inc., Grand Central Terminal, New York 17, N. Y. Murray Hill 6-0335

Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass. TRowbridge 6-2800

Camera Equipment Co., Inc., 315 W. 43rd St., New York 36, N. Y. JU-6-1420

Campbell Co., Inc., Colin, P.O. Box 529, Miry Brook Rd., Danbury, Conn. PIoneer 3-0701

Canadian Marconi Co., 2442 Trenton Ave., Montreal, P. Q., Canada. REgent 8-9441

Cannon Electric Co., 3208 Humboldt St., Los Angeles 31, Calif. CApitol 5-1251
Authorized Factory Source
Schweber Electronics
60 Herricks Rd., Mineola, L. I., N. Y.
PIoneer 6-6520

Cannon Instrument Co., P.O. Box 812, State College, Pa. Phone—Boalsburg, Pa. HO-6-6233

Capeway Instrument Corp., No. Bedford St., E. Bridgewater, Mass. DRake 8-2921

Capitron Div., AMP Inc., 155 Park St., Elizabethtown, Pa. EMpire 7-1105

Cargill Detroit Corp., 2254 Cole Ave., Birmingham, Mich.

Carlson Co., 3457 Weidner Ave., Oceanside, L. I., N. Y. ROckville Centre 4-8181

Carol Electronics Corp., 315 W. Stephen St., Martinsburg, W. Va. AMherst 7-8911

Carpenter Steel Co., 125 W. Bern St., Reading, Pa. FRanklin 4-8211

Carruthers & Fernandez, Inc., 1501 Colorado Ave., Santa Monica, Calif. EXbrook 4-6768

Carter Mfg. Corp., 23 Washington St., Hudson, Mass. HUdson 1309

Carter Motor Co., 2711 W. George St., Chicago 18, Ill. JU 8-7700

Cash Co., A. W., 540 N. 18th St., Decatur, Ill. Telephone 8-3401
Pittsburgh Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa.
WAlnut 1-6140

Cash Valve Mfg. Corp., A. W., 666 E. Wabash Ave., Decatur, Ill. Telephone 2-8574

Cassell Co., John R., 110 West 42nd St., New York 36, N. Y. WIsconsin 7-7678

Central Electronic Mfrs., Div. Nuclear Corp. of America, 2 Richwood Place, Denville, N. J. OAkwood 7-4200

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
(See advertisement on page 126)

Centralab, Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 12, Wis. WOodruff 2-9200

CENTRALAB SALES REPRESENTATIVES

CALIFORNIA: San Francisco
Logan Sales Co.
154 Eighth St., Hemlock 1-0692
CALIFORNIA: Beverly Hills
Walter S. Harmon Co.
P.O. Box 1380, Olympia 2-5616
COLORADO: Denver
McLoud & Raymond Co.
5402 E. Evans, SKyline 6-1589
GEORGIA: Atlanta
Frank Nickerson
1202 Zonolite Rd. N.E., Trinity 5-8908
ILLINOIS: Chicago
F. L. Tiegs & A. A. MacDonald
5308 W. Diversey, Palisade 5-5366
INDIANA: Indianapolis
L. M. DeVoe Co.
4010 Washington Blvd., Atwater 3-1395
IOWA: Cedar Rapids
Jerry Vrbik
615 Guaranty Bldg., Empire 4-0833
MASSACHUSETTS: Needham
Stanley A. Harris Co.
1241 Highland Ave., Hillcrest 4-4780
MICHIGAN: Detroit
R. C. Merchant
18411 W. McNichols Rd., Kenwood 5-6000
MINNESOTA: Minneapolis
Merrill K. Franklin
338 E. Franklin, Federal 6-2315
MISSOURI: Kansas City
E. W. McGrade
Box 8876, Prairie Village Sta., Randolph 2-0758
MISSOURI: St. Louis
Theodore B. Lowell
Box 21, Normandy Branch, Evergreen 5-7803
NEW JERSEY: Nutley
D. P. Galasso
382 Franklin Ave. North 1-1300
NEW YORK: Dewitt
George P. Marron
4455 E. Genessee, Gibson 6-1974
NEW YORK: Syracuse
Wilson H. Zimmerman
112 DeWitt, Granite 4-4889
OHIO: Brecksville
Allen Nace Co.
7601 Parkview Rd., Jackson 6-4323
PENNSYLVANIA: Philadelphia
R. K. MacDonald, Inc.
1531 Spruce St., Kingsley 5-1205
PENNSYLVANIA: Philadelphia
Jerome Bresson
246 Haverford Ave., Greenwood 7-3800
TENNESSEE: Memphis
Al S. Engelman
3205 Crump Avenue, Glendale 8-6263
TEXAS: Dallas
Robert E. Nesbitt
1925 Cedar Springs, Riverside 7-5824
WASHINGTON: Seattle
J. J. Backer Co.
221 Galer St., Atwater 3-6470
CANADA: Toronto
P. J. Heenan Co.
804 Mt. Pleasant Rd., Hudson 1-2291
CANADA: Vancouver
D. E. McLennan
1624 W. Third Ave. Bayview 2898
HAWAII: Honolulu
Jim Hastin Sales Co.
P.O. Box 2098-998910

Century Electronics & Instruments, Inc., 1333 N. Utica, Tulsa 10, Okla. LUther 4-7111

Ceramaseal, Inc., P.O. Box 25, New Lebanon Center, N. Y. W. Lebanon 3-5851

Ceramatronics, Inc., 364 Highland Ave., Passaic, N. J. GRegory 3-8274

Cerro de Pasco Sales Corp., 300 Park Ave., New York 22, N. Y. MUrray Hill 8-8822

Chadwick-Helmuth Co., 472 E. Duarte Rd., Monrovia, Calif. EL 84567

Chart-Pak, Inc., 1 River Rd., Leeds, Mass. JUstice 4-5446 (Northampton)

Chatillon, John & Sons, 85 Cliff St., New York 38, N. Y. BEekman 3-2552

Chemalloy Electronics Corp., Gillespie Airport, Santee, Calif.

Chemiquip Co., 36 East 10th St., New York 3, N. Y. GRamercy 7-3772

Chesapeake Instrument Corp., Shadyside, Md. UNiversity 7-2151

Chester Cable Corp., Chester N. Y., HOmestead 9-2141

Chicago-Allis Mfg. Corp., 113-125 N. Green St., Chicago 7, Ill. MO 6-5050

Chicago Minature Lamp Works, 1500 N. Ogden Ave. Chicago 10, Ill. MOhawk 4-1741
California & Southwest Representative
The George Agency
101 Verduga Avenue
Burbank, Calif., Victoria 9-3140
Northwest Representative
James J. Backer Company
221 West Galer Street
P.O. Box 9077
Seattle 99, Wash. ATwater 3-6470
Northeastern United States Representative
Hoffman Engineering Corp.
183 R. Sound Beach Ave.
Old Greenwich, Conn. NEptune 7-3557

Chicago Standard Transformer Corp., 3501 W. Addison St., Chicago 18, Ill. INdependence 3-7400

Chrono-Log Corp., Box 4587, Philadelphia 31, Pa. LOcust 7-5178
(See advertisement on page 86)

Churchill Lighting Corp., 344 Franklin St., Melrose 76, Mass. NOmandy 5-4700

Cincinnati Time Recorder Co., 1733 Central Ave., Cincinnati 14, Ohio. CHerry 1-1995

Circle Seal Products Co., Inc., 2181 E. Foothill Blvd., Pasadena, Calif. MUrray 1-4966
Northern California Representative
Power Transmission Engineering Corp.
86 Keyes St., San Jose, Calif.
CYpress 4-8181

Circo Ultrasonic Corp., 51 Terminal Ave., Clark, N. J.

Circon Component Corp., Santa Barbara Municipal Airport, Goleta, Calif. WOodland 7-1113
(See advertisement on page 193)

Clare & Co., C. P., 3101 Pratt Blvd., Chicago 45, Ill. AMbassador 2-7700

Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio. ULster 1-2000

Clark-Cooper Co., Inc., 305 Market St., Palmyra (Burl. Cty) N. J. TAlmadge 9-1447

Clark Flexible Link Shaft Co., P. O. Box 73, Newton Highlands 61, Mass.

Clark Manufacturing Co., 1830 E. 38th St., Cleveland 14, Ohio. EX 1-1414
Pittsburgh Area Representative
Forbes-Western, Inc.
940 Western Ave., Pittsburgh 33, Pa.
ALlegheny 1-9400

Clarostat Mfg. Co., Inc., Dover, N. H., SHerwood 2-1120

Clary Corp., Electronics Div., 404 Junipero St., San Gabriel, Calif. ATlantic 7-6111

Clegg Laboratories, Div. of Clegg, Inc., Ridgedale Ave., Morristown, N. J. JE 8-7214

Cleveland Worm & Gear Co., 3300 E. 80th St., Cleveland 4, Ohio. YU 3-4560

Clevite Transistor Products Div., Clevite Corp., 241 Crescent St., Waltham 54, Mass. TWinbrook 4-9330

Clifton Precision Prods. Co., Inc., Marple at Broadway, Clifton Heights, Pa. HIlltop 9-1200 (Sales)

Clough-Brengle Co., 6014 N. Broadway, Chicago 40, Ill. AMbassador 2-2200

Coast Coil Co., 5353 W. Washington Blvd., Los Angeles 16, Calif. WE 6-6188

Coast Instrument, Inc., 4811 Long Beach Blvd., Long Beach, Calif. NEvada 6-7683

Cobehn, Inc., 226 Passaic Ave., Caldwell, N. J. CApital 6-6675

Coleman Electronics, Inc., 133 East 162nd St., Gardena, Calif. FAculty 1-4775

Coleman Engineering Co., Inc., 3500 Torrance Blvd., Torrance, Calif. FAculty 1-3900

Coleman Instrument Co., Inc., 716 So. Troost, Tulsa 16, Okla. LUther 7-6691

Coleman Instruments, Inc., 42 Madison St. Maywood, Ill.

Collectron Corp., 304 E. 45th St., New York City 17, N. Y. MU 9-7120

Collins Corp., G. L., 2820 E. Hullett St., Long Beach 5, Calif. MEtcalf 0-3121

Collins Radio Co., 855 35th St., N.E., Cedar Rapids, Iowa. EMpire 30281

Colonial Kolonite Co., 2232 W. Armitage Ave., Chicago 47, Ill. CApitol 7-0300

Columbia Electric Mfg Co., 4519 Hamilton Ave., Cleveland 14, Ohio. ENdicott 1-8060

Columbia Technical Corp., 61-02 31st Ave., Woodside 77, N. Y. AS 8-7401

Colvin Laboratories, Inc., 364 Glenwood Ave., East Orange, N. J. ORange 7-1221
(See advertisement on page 52)

Comar Electric Co., 3340 Addison St., Chicago 18, Ill. JUniper 8-2410
(See advertisement on page 178)

Commercial Iron Works, 2424 Porter St., Los Angeles 21, Calif. MAdison 7-1051
(See advertisement on page 45)

DISTRIBUTORS OF COMMERCIAL ORIFICE FITTINGS

ALABAMA, WEST FLORIDA, NORTHERN MISSISSIPPI, CENTRAL TENNESSEE
Hudson Engineering Co., Inc.
1531 28th Ave. South, Birmingham 9, Ala.

ARKANSAS, KANSAS, OKLAHOMA
Vickery-Simms, Inc.
201 Enterprise Bldg., Tulsa, Oklahoma

CALIFORNIA
Paul Robinet & Co.
420 Market St., San Francisco 11, Calif.

COLORADO, MONTANA, UTAH, WYOMING
L. A. Christopher Co.
1715 York St., Denver 6, Colorado

DELAWARE, MARYLAND, S. NEW JERSEY, E. PENNSYLVANIA, VIRGINIA
Delaware Valley Engineering Co., Inc.
Forest & Hector Sts., Conshohocken, Pa.

FLORIDA PENINSULA, GEORGIA, EASTERN TENNESSEE
Jack M. Smither & Co.
3166 Maple Dr. N. E., Atlanta 5, Georgia

LOUISIANA
Coastal Engineering Co.
P.O. Box 1366, New Orleans 13, La.

NORTHERN NEW JERSEY, NEW YORK CITY METROPOLITAN AREA
Malcom W. Black & Co., Inc.
41 East 42nd St., New York 17, N. Y.

NEW YORK CITY METRO. AREA (EXPORT)
Black Export, Inc.
41 East 42nd St., New York 17, N. Y.

WEST NEW YORK, WEST PENNSYLVANIA, WEST VIRGINIA
M. S. Jacobs & Associates, Inc.,
810 Nobelstown Rd., Pittsburgh 5, Pa.

NORTH CAROLINA, SOUTH CAROLINA
Mason & Morris, Inc. (Box 1903)
1726 Hutchison Ave., Charlotte 1, N. C.

SOUTH & EAST TEXAS
Maintenance Mechanical Corp.
P.O. Box 2637, Houston 1, Texas

NORTH TEXAS
Vickery-Simms, Inc.
P.O. Box 67, Arlington, Texas

TEXAS PANHANDLE, OKLAHOMA PANHANDLE, W. KANSAS
James S. Kone & Co.
1701 N.E. Fourth St., Amarillo, Texas

WEST TEXAS, NEW MEXICO
Beal Equipment Co.
P.O. Box 3894, Odessa, Texas

MEXICO
Schultz Y Cia., S. A.
Lago Xochimilco 345, Mexico 17, D. F.
Aramberri, 509 Pte., Monterey, N. L. Mex

CANADA
Peacock Brothers, Ltd.,
Head Office: P.O. Box 1040, Montreal 3, Quebec.
Branch Offices: 1029 11th Ave. S. W., Calgary, Alberta; 10323 78th Ave., Edmonton, Alberta; 2325 Burrard, Vancouver 9, B.C.; 168 Market St., Winnipeg 2, Manitoba; P.O. Box 968, Sydney, Nova Scotia; 105 Durham St. S., Sudbury, Ontario; 1669 Eglinton Ave. W., Toronto 10, Ontario; 310 Victoria Ave., Montreal 6, Quebec.

Commercial Plastics Co., 945 George St., Chicago 14, Ill. GRace 7-8220

Communication Accessories Co., U. S. Highway 50 and 71 By-Pass, Lee's Summit, Mo. BRoadway 1-1700

Communication Measurements Lab., Inc., 350 Leland Ave., Plainfield, N. J.

CompuDyne Corp., 400 S. Warminster Rd., Hatboro, Penna.

California Representative
Luscombe Engineering Co.
1129 So. Fair Oaks Ave., Pasadena, Calif. MU-2-3386
Pittsburgh and Buffalo Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229
130 N. "B" St., San Mateo, Calif. DI-2-7057

Computer Control Co., Inc., 983 Concord St., Framingham, Mass. TRinity 5-6185

Western Division
R. D. Chamorro, Sales Manager
2251 Barry Ave., Los Angeles 64, Calif.
GRanite 8-0481, BRadshaw 2-9135

Computer Equipment Corp., 1921 Pontius Ave., Los Angeles 25, Calif. GRanite 8-0464

Computer Instruments Corp., 92 Madison Ave., Hempstead, L. I., N. Y. IVanhoe 3-8200

Computer Measurements Corp., 5528 Vineland Ave., North Hollywood, Calif.
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Conant Bros. Co., Inc., 427 Riverside Ave., Medford 55, Mass. EXport 5-2240

Conant Laboratories, Box 3997, Bethany Station, Lincoln 5, Neb. Telephone 4-0432

Conax Corp., 2300 Walden Ave., Buffalo 25, N. Y. REgent 0600

Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa. LOcust 7-7560
(See advertisement on pages 48, 51, 71, 161)

Conrad, Inc., 141 Jefferson St., Holland, Mich. EXport 2-3161

Consolidated Controls Corp., 11 Durant Ave., Bethel, Conn.

Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif. SYcamore 6-9381

Consolidated Systems Corp., 1500 So. Shamrock Ave., Monrovia, Calif. ELliott 9-8211

Consolidated Vacuum Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y. GLenwood 3-7972
(See advertisement on page 70)

Contact, Inc., Main St., Maynard, Mass. TW 7-2642

Continental-Diamond Fibre Corp., Newark, Del. ENdicott 8-8531

Continental Equipment Co., Div. of Fisher Governor Co., 200 Main St., Cornopolis, Penna. AM-4-3010

Representative—So. California Area
B. R. Jones & Company
2334 E. 8th St., Los Angeles 21, Calif.
MAdison 7-1867

Continental Pump Co., 1027 So. Vandeventer, St. Louis 10, Mo. JEfferson 1-2840

Continental Screw Co., 459 Mt. Pleasant St., New Bedford, Mass. WY 3-2621

Control Data Corp., 501 Park Ave, Minneapolis 15, Minn. FEderal 9-0947

Control Panel Corp., 517 W. Monroe St., Chicago 6, Ill. DEarborn 2-3228

Control Products Inc., 306 Sussex St., Harrison, N. J. HU. 2-0213

Control Technology Co., 1186 Broadway, New York 1, N. Y. ORegon 9-2770

Controls Co. of America, 9555 Soreng Ave., Schiller Park, Ill. NA 5-9000

Cook Co., Frank R., 3850 Olive St., Denver 7, Colo. FLorida 5-3531

Cooper Development Corp., 2626 So. Peck Rd., Monrovia, Calif. HIllcrest 6-3138

Coors Porcelain Co., 600 9th St., Golden, Colorado. CR 9-4533

Copease Corp., 425 Park Ave., New York 22, N. Y. PLaza 3-6692

Corbett Science Labs., F. W., 3117 Venice Blvd., Los Angeles 19, Calif. REpublic 3-5251

Corbin Cabinet Lock Div., 102 Washington St., New Britain, Conn. BAldwin 5-7411

Corning Glass Works, Corning, N. Y. Telephone 2-5011

Corson Electric Mfg. Corp., 540 - 39th St., Union City, N. J. UNion 6-4227

Cosa Corp., 405 Lexington Ave., New York 17, N. Y. YUkon 6-9696

Coulter Industrial Sales Co., P. O. Box 22, Elmhurst, Ill. TErrace 2-5653

Cox Instruments Div., Geo. L. Nankervis Co., 15300 Fullerton, Detroit 27, Mich. VErmont 8-5780

Cramer Controls Corp., Centerbrook, Conn., SOuth 7-8255

Crawford Co., C. B., 16606 Waterloo Rd., Cleveland 10, Ohio. KE 1-5415

Crawford Fitting Co., 884 East 140th St., Cleveland 10, O. Liberty 1-5533
(See advertisement on page 147)

Rep—Pittsburgh, Pa., Charleston, W. Va.
Fogleman Co., Inc.
3849 Willow Ave., Pittsburg 34, Pa. LE-1-4005
510 "C" St., S. Charleston 3, W. Va. RI-4-8401

Crescent Insulated Wire & Cable Co., P. O. Box 850, Trenton 5, N. J. EXport 6-9111
(See advertisement on page 144)

Rep—Pittsburgh, Pa., Charleston, W. Va.
Fogleman Co., Inc.
3849 Willow Ave., Pittsburgh 34, Pa. LE-1-4005
510 "C" St., S. Charleston 3, W. Va. RI-4-8401

Crest Instrument Co., 11808 S. Bloomfield Ave., Santa Fe Springs, Calif. UNiversity 3-4781

Croname Inc., 6251 Howard St., Chicago 48, Ill. NIles 7-6100

Crosby Valve & Gage Co. - The Ashton Valve Co., 43 Kendrick St., Wrentham, Mass. EVergreen 4-3121

Crucible Steel Co. of America, P. O. Box 2516, Pittsburgh 30, Pa. ATlantic 1-3800

Crump Instrument Corp. (Subsidiary of Houston Instr. Corp.), 1520 Foley St., Houston 24, Tex. HOmestead 8-2969
(See advertisement on page 64)

Crystal Glass Tube & Cylinder Co., 7310 S. South Chicago Ave., Chicago 19, Ill. DO-3-3277
(See advertisement on page 190)

Cubic Corp., 5575 Kearny Villa Road, San Diego 11, Calif. BRowning 7-6780

Cunningham, Son & Co., Jas., 33 Litchfield St., Rochester 8, N. Y. BAker 5-7240

Curtis Laboratories, Inc., 2718 Griffith Park Blvd., Los Angeles 27, Calif. NOrmandy 2-1176

Curtiss-Wright Corp., Electronics Div., 631 Central Ave., Carlstadt, N. J. GEneva 8-4000. IMI Branch, 4401 Lunada Ave. SE, P. O. Box 8324, Albuquerque, N. Mex. AMherst 8-8791

Cushman Precision Industries, 262 Alexander St., Princeton, N. J. WAlnut 1-7008

Custom Scientific Instruments, Inc., 541 Devon St., Kearny, N. J. WYman 1-6403

Customline Control Panels, Inc., 1379 East Linden Ave., Linden, N. J. HUnter 6-1272

Cutler-Hammer, Inc., 256 No. 12th St., Milwaukee 1, Wis. BRoadway 1-7800

D

D&R Ltd., 402 E. Gutierrez, P. O. Box 1500, Santa Barbara, Calif. WOodland 3116

Dage Television Div., Thompson-Ramo-Wooldridge, W. 10th St., Michigan City, Ind. TR 4-3251

Dahl Co., Geo. W., 86 Tupelo St., Bristol, R. I. CLifford 3-9500
(See advertisement on page 74)

Rep—W. Pa., W. Va., Md. Panhandle, Ohio Border
Sentinel Products Co. (Wayne B. Farley)
36 Beltzhoover Ave., Pittsburgh 10, Pa.
HEmlock 1-0774

Dalmotor Div., Yuba Consolidated Industries, Inc., 1375 Clay St., Santa Clara, Calif. CHerry 3-9414

Daniel Orifice Fitting Co., Inc., 9720 Katy Rd., Houston 24, Texas. HO 5-3451

Pittsburgh Area Representative
W. A. Stoeltzing, Inc.
940 Western Ave., Pittsburgh 33, Pa.
ALlegheny 1-9400

Darrill Products Corp., 95 Falmouth St., Attleboro, Mass. ATtleboro 1-4047

Datex Corp., 1307 So. Myrtle Ave., Monrovia, Calif. ELliott 9-5381

Datran Electronics, 1836 Rosecrans Ave., Manhattan Beach, Calif. OSborne 57131 - ORegon 80808

Daven Company, 530 W. Mt. Pleasant Ave., Livingston, N. J. WYman 2-4300

Davenport Mfg. Co., 2530-32 N. Elston Ave., Chicago 47, Ill. DIckens 2-5620

Davidson Optronics, Inc., 223 Ramona Blvd., West Covina, Calif. EDgewood 7-7281
(See advertisement on pages 122, 134)

Davies Brothers, Gladstone, N. J., PEapack 8-1290

Davis Instruments, 47 Hallock St., Newark 4, N. J. HUmboldt 2-3660
(See advertisement on page 39)

Detroit Representative
The Basic Service Corp.
16544 Plymouth Rd., Detroit, Mich.
VErmont 7-8820

Rep—Ga., Fla., E. Tenn., S. C., Ala.
Lewis M. Crowe Co.
111 Tuxedo Terrace, N.W., Atlanta 5, Ga.
CEdar 7-9209

Pittsburgh and Buffalo Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3329

Rep—New York, New Jersey Area
George H. Birchall Co., Inc.
P. O. Box 84, Westfield, N. J.
ADams 2-3600

Texas-Louisiana Representative
Industrial Scientific, Inc.
2920 Shotts St., Ft. Worth 1, Tex. ED-6-2518
317 Nagle St., Houston 1, Tex. CA-8-0376
27th & Westover, Odessa, Tex. FE-28531
4543 North Blvd., Baton Rouge, La. DI-8-3616

Daystrom Instrument, Archbald, Pa. Jermyn, Pa. 1100

Daystrom Transicoil Corp., Worcester, Penna.
Dallas Representative
Allied Components Inc.
2517 Converse St., Dallas 7, Texas
RIverside 2-2830

Daytronic Corp., 216 S. Main St., Dayton 2, Ohio. BAldwin 3-7618

Dearborn Glass Co., 6600 S. Harlem Ave., Bedford Park, Ill. LU 5-0900

Decker Corp., 45 Monument Rd., Bala-Cynwyd, Penna. MOhawk 4-7010

Defender Instrument & Regulator Co., Boody, Ill. ELwin 2519

DeJur-Amsco Corp., Industrial Sales Div., 45-01 Northern Blvd., Long Island City 1, N. Y. RAvenswood 1-4009

Dekeron Products Div., (see Samuel Moore & Co.)

Del Electronics Corp., 521 Homestead Ave., Mt. Vernon, N. Y. OWens 9-3232

Delco Radio Div., General Motors Corp., 700 E. Firmin, Kokomo, Ind. GLadstone 2-8211

Delta-f, Inc., 113 E. State St., Geneva, Ill. Telephone 5600

DeMornay-Bonardi, 780 So. Arroyo Parkway, Pasadena, Calif. SYcamore 3-4143
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Denison Engineering Div., American Brake Shoe Co., 1160 Dublin Road, Columbus 16, Ohio. HUdson 8-1191

Derbyshire, Inc., F. W., 157 High St., Waltham, Mass.
(See advertisement on page 191)

Designers for Industry, Inc., 4341 Fulton Pkwy., Cleveland 9, Ohio. SHadyside 9-0700

Designs for Tomorrow, Inc., 6425 Etzel Ave., St. Louis 33, Mo. PArkview 6-5222

Detecto Scales, Inc., 540 Park Ave., Brooklyn 5, N. Y. MA 4-6100

Detroit Coil Co., 2435 Hilton Rd., Ferndale 20, Mich. JOrdan 6-3950

Detroit Controls Div., American Standard Corp., 5900 Trumbull Ave., Detroit 8, Mich. TRinity 2-0300

Deutsch Company, 700 Avalon Blvd., Los Angeles 3, Calif. PLeasant 1-4131 - LUdlow 3-6421

Devoe Engineering, Inc., Pier Lane West, Caldwell, N. J. CApital 6-0610

Devron Corp., 400 Endicott St., Danvers, Mass. SP 4-1990, 1991

Development Engineering Co., Inc., 9 Cross St., Norwalk, Conn. VOlunteer 6-7720
(See advertisement on page 33)

DeZurik Corp., Sartell, Minn. BLackburn 1-0221
Pittsburgh and Buffalo Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229

Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y. HYacinth 7-7900
(See advertisement on page 80)

Dialtron Corp., 308 Harrison Place, Brooklyn 37, N. Y. HYacinth 7-7600

Diamond Antenna & Microwave Corp., 7 North Ave., Wakefield, Mass. CRystal 9-4650

Diamond Power Specialty Corp., Electronics Div., P. O. Box 415, Lancaster, Ohio. OLive 3-6540

Dian Laboratories, Inc., 611 Broadway, New York 12, N. Y. AL 4-6555

Di/An Controls, Inc., 40 Leon St., Boston 15 Mass. HIghlands 5-5640

Dice Company, J. W., 16 Highwood Ave., Englewood, N. J. LOwell 9-0471
(See advertisement on page 138)

Dickson Company, 7420 Woodlawn Ave., Chicago 19, Ill. PLaza 2-0089

California Representative
Carkeek Engineering Co.
285 S. Euclid Ave., Pasadena, Calif.
MUrray 1-0489

Diehl Manufacturing Co., Sub. of The Singer Mfg. Co., 1116 Pinderne Ave., Somerville, N. J. RAndolph 5-2200

MILITARY PRODUCTS DEPARTMENT
District Offices

CHICAGO 7, ILL.
1019 West Jackson Boulevard
TAylor 9-4556

CLEVELAND 14, OHIO
2117 Superior Avenue
MAin 1-4852

NEEDHAM HEIGHTS 94, MASS.
360 First Avenue
HIllcrest 4-4380

WASHINGTON 6, D. C.
1707 H Street, N.W.
District 7-3426

Representatives

ATLANTA 9, GA.
Scientific Sales Engrg. Co.,
2162 Piedmont Rd., N.E. TRinity 5-7291

DALLAS 35, TEX.
Air Equipment Sales Co.,
P.O. Box 35012, Inwood Rd., FLeetwood 2-6943

DENVER 22, COLO.
Spicer-Lindsay Associates,
4690 E. Evans Ave. SKyline 6-0627

PASADENA, CALIF.
Luscombe Engineering Co.,
1129 S. Fair Oaks Ave., RYan 1-5556

SCARBOROUGH, ONT.
Douglas Randall (Canada) Ltd.,
126 Manville Rd., PLymouth 9-2391

ST. PETERSBURG, FLA.
Scientific Sales Engineering Co.,
918 Snell Isle Blvd., St. Petersburg 5-7874

SAN MATEO, CALIF.
Luscombe Engineering Co., 130 N. "B" St.

Distert Co., Harry W., 9330 Roselawn Ave., Detroit 4, Mich. WEbster 3-9790

Dietz Design & Mfg. Co., 12921 Fifth St., Grandview 17, Mo. SOuth 1-7216

Dietz Co., Inc., Henry G., 12-16 Astoria Blvd., Long Island City 2, N. Y. RAvenswood 6-3847

Diffraction Prod. Inc., 1400 So. 14th Ave., Maywood, Ill. FI 3-1546

Digitran Co., 45 W. Union St., Pasadena, Calif. RYan 1-9667

Digitronics Corp., Albertson Ave., Albertson, L. I., N. Y. PIoneer 7-5090

Dillen & Co., W. C., Inc., 14620 Keswick St., Van Nuys, Calif. STate 5-3168
(See advertisement on page 139)

Detroit Representative
The Basic Service Corp.
16544 Plymouth Rd., Detroit, Mich.
VErmont 7-8820

New Jersey Representative
The Truesdell Company
No. 7 Spring St., Princeton, N. J.
WAlnut 1-8779

Dimco-Gray Co., 207 E. 6th St., Dayton 2, Ohio. BAldwin 2-6706
(See advertisement on page 203)

Disc Instruments Inc., 12671 Bubbling Well Road, Santa Ana, California. Lincoln 4-0210
(See advertisement on page 203)

Dit-Mco Inc., Electronics Div., 911 Broadway, Kansas City 5, Mo. HArrison 1-8484

Dixon Inc., William, 32-42 E. Kinney St., Newark 1, N. J.
(See advertisement on page 194)

DJECO Div. of Djordjevic Engineering Co., 1933 N. Damen, Chicago 47, Ill. ARmitage 6-7308

Dmeter Mfg. Co., Inc., 22-24 Larkin Plaza, Yonkers, N. Y. YOnkers 9-1770

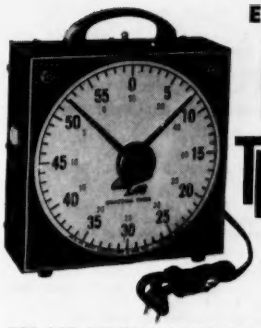
Dolinko & Wilkens, Inc., 1907 Summit Ave., Union City, N. J. UNion 7-6630

Donner Scientific Co., 888 Galindo St., Concord, Calif. MUlberry 2-6161

Dorne and Margolin, Inc., 29 New York Ave., Westbury, L. I., N. Y. EDgewood 4-3200

Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.

Dragon Engineering Co., Inc., P. O. Box 185, Norwalk, Calif. UNiversity 8-5224
(See advertisement on page 74)



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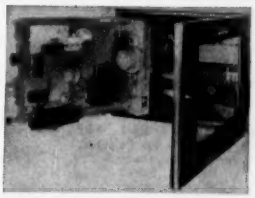

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WAlnut 1-8779

Drake Mfg. Co., 4626 No. Olcott, Harwood Heights, Chicago 31, Ill. UN 7-7227
(See advertisement on page 172)

Dressen-Barnes Corp., 250 No. Vinedo Ave., Pasadena, Calif. SYcamore 5-7731

Driver Co., Wilbur B., 1875 McCarter Highway, Newark 4, N. J. HUmboldt 2-5550

Dryomatic Corp., 806 N. Fairfax St., Alexandria, Va. KIng 9-3060

Ducommun Co., M., Dept. IN, 580 Fifth Ave., New York 36, N. Y. PLaza 7-2540
(See advertisement on page 203)

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Dunn Engineering Associates, Inc., 225 O'Brien Highway, Cambridge 41, Mass. UNiversity 4-6700

Duraknol, Inc., 1010 North Main St., Elkhart, Ind.

Durolab Equipment Corp., 979 Linwood St., Brooklyn 8, N. Y. NI 9-0581

Durant Mfg. Co., 1914 N. Buffum St., Milwaukee 1, Wis. LOcust 2-5035

Dwyer Mfg. Co., F. W., P. O. Box 373, Michigan City, Ind. TRiangle 2-4232, SE-3-7883
(See advertisement on page 54)

Dymec, Inc., 395 Page Mill Rd., Palo Alto, Calif. DA 6-1755

Dyna-Empire, Inc., 1075 Stewart Ave., Garden City, N. Y. Pioneer 1-2700
(See advertisement on page 106)

REPRESENTATIVES

Van Nuys, California
The Kennematt Co. (Mr. Kenneth Cox)
P. O. Box 2007, 14637 Bessemer St.
STanley 3-2427

Aurora, Illinois
Dwight Smith & Associates (Mr. Dwight Smith)
9 South River St., TWinoaks 7-5752

Dallas, Texas
Southwestern Engrg. Equipt. Co. (Mr. Fred Harmon)
3906 Lemmon Ave., LOgan 7433

Dynamatic Div., Eaton Mfg. Co., 3122 14th Ave., Kenosha, Wis. OL 7-6171

Dynametrics Corp., Northwest Industrial Park, Burlington, Mass. BRowning 2-1600
(See advertisement on page 45)

Dynamic Gear Co., Inc., 30 Merrick Rd., Amityville, L. I., N. Y. AM 4-4788

Dynamic Instrument Co., Inc., 42 Carleton St., Cambridge 42, Mass. UN 4-7260
(See advertisement on page 49)

Rep—E. Pa., S. N. J., Dela., Md., D. C., Va.
Polymetric Devices Co., Inc.
P. O. Box 236, Glenside, Pa. TU-7-4873
P. O. Box 246, Silver Spring, Md.

Dynamic Instrument Corp., 59 New York Ave., Westbury, L. I., N. Y. EDgewood 3-1600

Dynamics Instrumentation Co., Div. of Alberhill Corp., 1118 Mission St., So. Pasadena, Calif. RYan 13318

Dynamics Research Corp., 44 Winn St., Woburn, Mass. WElls 3-7100
(See advertisement on page 152)

Dynapar Corp., 5150 Church St., Skokie, Ill. ORchard 4-6655

Dynatronics, Inc., 717 W. Amelia Ave., Orlando, Fla. GA 3-8691

Dyneers, P. O. Box 58, Chatham, N. J.

E

EMP Electronics Research Laboratories, Inc., 3131 No. 29th Ave., Phoenix, Ariz. ALpine 8-2462

ESC Corp., 534 Bergen Blvd., Palisades Park, N. J. WIndsor 7-0400

E-T-A Products Co. of America, 6284 No. Cicero Ave., Chicago 46, Ill. Kildare 5-1554

E & W Optical Co., 2406 E. Hennepin, Minneapolis 13, Minn. FR 1-9864

Eagle Signal Co., Div. The Gamewell Co., 202 20th St., Moline, Ill. Moline 2-5571

Eastern Air Devices, Inc., 385 Central Ave., Dover, N. H.

Eastern Industries, Inc., 100 Skiff St., Hamden 14, Conn. CH 8-3841

Eastern Reproductions Corp., 1250 Main St., Waltham 54, Mass. TW 3-0555 -6 -7

Eastern Specialty Co., 3617-19 No. 8th St., Philadelphia 40, Pa. BAldwin 8-0500

Eastman Kodak Co., 343 State St., Rochester 4, N. Y. LO 2-6000

Eberline Instrument Corp., 805 Early, Santa Fe, N. Mex. YUcca 21881

Ebert Electronics Corp., 212-26 Jamaica Ave., Queens Village 28, N. Y. SPruce 6-1800
(See advertisement on page 177)

EBEX, 1015 Atkin Ave., Salt Lake City 6, Utah

Eclipse Fuel Engineering Co., Rockford, Ill. WOodland 8-3751

Eder Engineering Co., Inc., 1568 S. 1st St., Milwaukee 4, Wis. EVergreen 3-3900

Eder Instrument Co. Inc., 2293 N. Clybourn Ave., Chicago 14, Ill. EAstgate 7-2131
(See advertisement on page 135)

Edison Industries, T. A., Instrument Div., Mc-Graw Edison Co., 24 Lakeside Ave., W. Orange, N. J. ORange 3-6600

Editape Company, 32 Central Parkway, Huntington, L. I., N. Y. HAmilton 1-0929

Edmund Scientific Co., 101 E. Gloucester Pk., Barrington, N. J. LIncoln 7-3488

Ednalite Optical Co., Inc., 200 N. Water St., Peekskill, N. Y. PE-7-6100

Edward Valves, Inc., Sub. of Rockwell Mfg. Co., 1200 W. 145th St., East Chicago, Ind. EXport 7-3231

Edwards Co., Inc., 90 Connecticut Ave., Norwalk, Conn. TEmple 8-8441

Eicor Div. of The Scranton Corp., 4059 W. North Ave., Chicago 39, Ill. HUmboldt 6-2060

Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, Calif. LYtell 1-1451

El Products Corp., P. O. Box 41, New York 63, N. Y. KI-8-3948
(See advertisement on page 205)

Elco Corp., "M" St. below Erie Ave., Philadelphia 24, Pa.

Elcor, Inc., 1225 W. Broad St., Falls Church, Va. JEfferson 2-8850

Electra Manufacturing Co., 4051 Broadway, Kansas City, Mo. WEstport 1-6864

Electric Auto-Lite Co., Champlain St., Toledo 1, Ohio. CHerry 2-3131

Electric Design & Mfg. Co., 8th & Jefferson, Burlington, Iowa. PLaza 2-7685

Electric Eye Equipment Co., 1938 E. Fairchild St., Danville, Ill. Telephone 6-6500

Electric Hotpack Co., Inc., Dept. 627, Cottman & Melrose Sts., Philadelphia 35, Pa. DE 3-1700

Electric Regulator Corp., Norwalk, Conn. VIctor 7-2401

Electric Tachometer Corp., 68th & Upland Sts., Philadelphia 42, Pa. SAratoga 6-7723

Electro Development Co., 14701 Keswick St., Van Nuys, Calif. STanley 3-1850
(See advertisement on page 193)

Electro Devices Inc., 580 Main St., Wilmington, Mass. PArkview 9-2851

Electro Devices, Inc., 4648 Easton Ave., St. Louis 13, Mo. JEfferson 1-2075

Electro Instruments, Inc., 3540 Aero Court, San Diego 11, Calif. BRowning 7-6590

Electro Precision Corp., P. O. Box 669, Arkadelphia, Ark. CHapel 6-2272

Electro Products Laboratories, Inc., 4501 N. Ravenswood Ave., Chicago 40, Ill. LOngbeach 1-1707

Electro-Autosizing Machine Corp., 7 William St., Closter, N. J. CLoster 5-5540

Electrodata Div., Burroughs Corp., 460 Sierra Madre Villa, Pasadena, Calif. RYan 1-0471

Electrol, Inc., Dept. 9, 9000 West Pico Blvd., Los Angeles 35, Calif. BRadshaw 2-6010
(See advertisement on page 81)

Electro-Measurements, Inc., 7524 S.W. Macadam, Portland 19, Oregon. CHerry 6-3332

Electro-Mec Laboratory, Inc., 47-51 33rd St., Long Island City 1, N. Y. STillwell 6-3402
(See advertisement on page 80)

Electro-Mechanical Research, Inc., P. O. Box 3041, Sarasota, Fla. RIngling 6-1148

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Electro-Mechano Co., 261 Erie St., Milwaukee 2, Wis.
(See advertisement on page 204)

Electro-Medical Laboratory, Inc., So. Woodstock 7, Vt. WOodstock 144-M-4
(See advertisement on page 140)

Electro-Miniatures Corp., 610 Huyler St., So. Hackensack, N. J. HUbbard 9-7770

Electro Switch Corp., Weymouth 88, Massachusetts
(See advertisement on page 181)

Electron Arc Inc., 244 Broad St., Lynn, Mass.

Electronic Applications, Inc., 194 Richmond Hill Ave., Stamford, Conn. DA 5-1574

Electronic Associates, Inc., Long Branch, N. J. CApital 9-1100

Electronic Computer Co., 618 Maple St., Conshohocken, Pa. TAylor 8-3967

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Electronic Fabricators, Inc., 682 Broadway, New York 12, N. Y. SPringhill 7-4900

Electronic Heat Treating & Mfg., Inc., 181 North Getty, Muskegon, Mich.
(See advertisement on page 183)

Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y. STillwell 6-8700

Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J. LIberty 2-0300

Electronic Parts Mfg. Co., 503 -25th St., Union City, N. J. UN. 5-4028

Electronic Processes Corp. of Calif., 436 Bryant St., San Francisco 7, Calif. EXbrook 7-3881

Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa. CHestnut Hill 7-6800

Electronics International Co., 145 W. Magnolia Blvd., Burbank, Calif. VI 9-2481

Electrons, Inc., 127 Sussex Ave., Newark 3, N. J. HU. 2-5977

Electrosnap Corp., 4218 W. Lake St., Chicago 24, Ill. VAnburen 6-3100

Electrosolids Corp., 13745 Saticoy St., Panorama City, Cal. STate 2-1410

Electrovert, Inc., 124 E. 40th St., New York 16, N. Y. OXford 7-8396

Elgin Metalformers Corp., 630 Congdon Ave., Elgin, Ill. SHerwood 1-13490

Elgin National Watch Co., Abrasives Div., 107 National St., Elgin, Ill. SHerwood 2-3300

Ellis Associates, 67 Lincoln Ave., Pelham, N. Y. PElham 8-3560
(See advertisement on page 137)

Ellison Draft Gage Co., 548 W. Monroe St., Chicago 6, Ill. RAndolph 6-2296

ELLISON REPRESENTATIVES

Carolinas
Applied Engineering Company
Greensboro, North Carolina
P.O. Box 506, Orangeburg, South Carolina

Florida
H. K. Wilson
2126—14th St., St. Petersburg, Fla.

Georgia
Spotswood Parker & Company
313 Techwood Dr., N. W., Atlanta Ga.

New Jersey—New York
Charles C. Phelps Company, Inc.
700 New Work Ave., Union City, N. J.
(NJ) Union City 7-9150 (NY) Barclay 7-1822

Ohio
McLean-Peterson Company
6809 Stewart Rd., Cincinnati 36, Ohio
Tweed 1-1570
Asmead-Danks Company
316 Marian Bldg., Cleveland 13, Ohio

Pittsburgh and Buffalo
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229

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Delta Instrument Co.
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P. O. Box 41 New York 63, N. Y.
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Emery Company, A. H., Pine St., New Canaan, Conn.
(See advertisement on page 43)

Empire State Laboratories, Inc., Bellmore Gear Div., 2606 Merrick Road, Bellmore N. Y. SUnset 5-4888
(See advertisement on page 166)

Engelhard Industries, Inc., 113 Astor St., Newark, N. J. BIgelow 3-0030

Engineered Electronics Co., 506 E. First St., Santa Ana, Calif. KImberly 7-5651

Engineered Magnetics, 13041 Cerise Ave., Hawthorne, Calif. OR-8-7607

Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill. HArrison 7-3223

Engler Instrument Co., 250 Culver Ave., Jersey City 5, N. J. HEnderson 4-6500

Entron, Inc., P. O. Box 287, Bladensburg, Md. APpleton 7-9585

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Digby 9-2470
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Energy Kontrols, Inc., 11 So. First St., Geneva, Ill. GEneva 7150

Epic, Inc., 154 Nassau St., New York 38, N. Y. Digby 9-2470
(See advertisement on page 205)

Eppley Laboratory, Inc., 12 Sheffield Ave., Newport, R. I. Viking 7-1020
(See advertisement on Inside Front Cover, page 178)

Epsco, Inc., 275 Massachusetts Ave., Cambridge, Mass.
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Erie Pacific, Div. of Erie Resistor Corp., 12932 S. Weber Way, Hawthorne, Calif. ORegon 8-5418

Erie Resistor Corp., 644 W. 12th St., Erie 6, Pa. GLendale 6-5892

Eriez Manufacturing Co., 1945 Grove Drive, Erie, Pa. Telephone 4-0133

Erwood Inc., 1770 W. Berteau Ave., Chicago 25, Ill. BI 8-0622

Essex Electronics, 550 Springfield Ave., Berkley Heights, N. J. CRestview 3-9300

Esterline-Angus Co., Dept. G, P. O. Box 596, Indianapolis 6, Ind. CHapel 4-3318
(See advertisement on page 106)

PRODUCT REPRESENTATIVES

Amarillo, Texas
C. B. Anderson Electric Co.
P.O. Box 1836. Drake 6-6443

Atlanta 19, Georgia
The Gearhart Company
The Gearhart Bldg. CEdar 3-4431

Birmingham 5, Alabama
The Gearhart Company
512 N. 18th St. ALpine 2-7419

Boston (Stoneham) 80, Mass.
L. S. Kirmes
P.O. Box 192. SToneham 6-1410

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The Robert F. Lamb Company
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Calgary, Alberta, Canada
George M. Fraser, Ltd.
1028—39th Ave., N. W. AVenue 9-7897

Chicago 5, Illinois
Murphy & Dickey
537 S. Dearborn St. HArrison 7-7953

Cincinnati, Ohio
G. H. Armstrong Co.
P.O. Box 25, Station K. KIrby 1-3692

Cleveland 15, Ohio
The L. H. Waldrip Company
3030 Euclid Ave. EXpress 1-4242

Dallas 20, Texas
Kemp Engineering Company
P.O. Box 13251. FLeetwood 7-8663

Denver 2, Colorado
Montain States Machinery Company
1526 Blake St. CHerry 4-7421

Des Moines, Iowa
Deco Engineering Products
1112 Locust St. ATlantic 8-5721

Detroit 27, Michigan
E. B. Anderson Company
12810 Puritan Ave. UNiversity 2-7705

Houston 19, Texas
The Eads Company
P.O. Box 13071. JAckson 8-6667

Indianapolis 4, Indiana
C. D. Arnold
911 N. Pennsylvania St. MElrose 4-3811

Kansas City, Missouri
C. B. Fall Company
P.O. Box 9744, Hickman Mills. SOuth 1-6545

Knoxville, Tennessee
Bowditch & Company
P.O. Box 3145. Tel. 4-2513

Los Angeles 46, California
Brenner-Fiedler & Associates
7563 Melrose Ave. WEbster 3-3811

Milwaukee 12, Wisconsin
M. F. Jacobs Company
808 W. North Ave., Suite 402. LOcust 2-5690

Minneapolis 3, Minnesota
Pinkney & Hine
1925 Nicollet Ave. FEderal 8-0533

Montreal, Quebec, Canada
W. Hobson & Associates
1024 Notre Dame St., Lachine. MElrose 7-1231

New Orleans 25, Louisiana
Mid-South Sales Company
P.O. Box 13032. TUlane 4683

New York
T. A. Kenny
P.O. Box 266, Summit, N. J. CRestview 3-7090

Oklahoma City 1, Oklahoma
C. B. Anderson Electric Company
P.O. Box 761. Victor 3-7718

Omaha 2, Nebraska
Deco Engineering Products
712 South 24th St. JAckson 4111

Philadelphia 2, Pennsylvania
Linn O. Morrow & Son
Schaff Building. LOcust 7-6431

Phoenix, Arizona
J. E. Redmond Supply Co.
P.O. Box 869. ALpine 4-8471

Pittsburgh 16, Pennsylvania
W. H. Bollinger
P.O. Box 8088. LOcust 1-2340

St. Louis, Missouri
C. B. Fall Company
317 N. 11th St., Room 1003. CHestnut 1-2433

Salt Lake City 10, Utah
C. H. Spencer & Company
P.O. Box 1054. Dial 6-8683

San Francisco, California
The T. R. Routh Co.
P.O. Box 1056, Burlingame. DIamond 2-4147

Seattle 99, Washington
Eicher & Company
5 W. Harrison St. ATwater 4-1811

Syracuse 14, New York
J. F. Wulfetange, Jr.
4505 E. Genesee St., DeWitt Br. GIbson 6-3330

Toronto 7, Ontario, Canada
George M. Fraser, Ltd.
1554 Yonge St. WAlnut 4-9492

Tulsa 3, Oklahoma
C. B. Anderson Electric Company
712 Oil Capitol Bldg. GIbson 7-1123

Washington, D. C.
The Hildenbrand Company
P.O. Box 1060, Fairfax, Va. CRescent 3-2334

Etching Co. of Calif., 1208 Howard St., San Francisco 3, Calif. MArket 1-7670

Ever Ready Thermometer Co., 116 Wooster St., New York 12, N. Y. CAnal 6-4595

Ewald Instruments, Route 7F, Kent, Conn. WAlker 7-3278

Exact Weight Scale Co., 551 East Town St., Columbus 15, Ohio. CA 4-6187

Exactel Instrument Co., 185 Evelyn Ave., Los Altos, Calif. YOrkshire 8-6558
(See advertisement on page 28)

Exline Engineering Co., 107 W. 2nd., Tulsa 3, Okla. GIbson 7-4481

F

FAE Instrument Corp., 42-61 Hunter St., Long Island City 1, N. Y. STillwell 6-4959

Fafnir Bearing Co., 37 Booth St., New Britain, Conn. BAldwin 5-5151

Fairchild Camera & Instrument Corp., Robbins Lane, Syosset, N. Y. WEIls 1-4500

Fairchild Controls Corp., Components Div., 225 Park Ave., Hicksville, L. I., N. Y. WEIls 8-5600

Fairfield Engineering Corp., 934 Hope St., Springdale, Conn. DA 5-1561

Falcon Alarm Co., Inc., 243 Broad St., Summit, N. J. CRestview 3-5640

Falstrom Company, Falstrom Court, Passaic, N. J. PR 7-0013
(See advertisement on page 186)

Farmer Electric Products Co., Inc., 2300 Washington St., Newton Lower Falls 62, Mass. DEcatur 2-8383
(See advertisement on page 58)

Farris Engineering Corp., 400 Commercial Ave., Palisades Park, N. J. WIndsor 4-6300
Rep—Pittsburgh, Pa., Charleston, W. Va.
Fogleman Co., Inc.
3849 Willow Ave., Pittsburgh 34, Pa. LE-1-4005
510 "C" St., S. Charleston 3, W. Va. RI-4-8401

Fecker, J. W., Inc., 6592 Hamilton Ave., Pittsburgh 6, Pa. EMerson 1-7617

Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.
(See advertisement on page 89)

California
G. B. Miller Company
1550 No. Highland, P.O. Box 1471
Hollywood 28, California
Hollywood 2-1195

Canada
John S. Plewes Company
52 Humbercrest Blvd.
Toronto 9, Ontario, Canada
Roger 9-2051

District of Columbia
Commercial Engineering Company
1627 K Street N.W.
Washington 6, DC
National 8-9238

Iowa
Deco Engineering Products
1112 Locust Street
Des Moines 7, Iowa
Atlanta 8-5721

Missouri
The Gaines Company
435 Westport Road
Kansas City 11, Mo.
Westport 1-5734

Massachusetts
Pacent Welling Inc
30 Providence St., Boston, Mass
Hancock 6-3248

New York
Carse Electric Company
1044 Broadway
Albany, New York
62-5364

New York
E. J. Robinson Associates
546 Niagara Street

Federal Pacific Reps Cont'd on page 206

Federal Pacific Reps Contd. from page 205

Buffalo, New York
Summer-7350

New York
Pacent Engineering Corporation
300 Northern Blvd.
Great Neck, L.I., New York
Murray Hill 3-1586
Hunter 2-4678

New York
Kahant Associates
11 Park Place
New York 7, New York
Cortland 7-5326

New York
E. J. Robinson Associates
536 Robinson Road
Syracuse, New York
Granite 3-2241

North Carolina
J. L. Highsmith Company
3733 Monroe Road
Charlotte 5, N. C.
Franklin 7-2546

Pennsylvania
Pacent Engineering Corporation
119 East Butler Avenue
Ambler, Pennsylvania
Mitchell 6-9405

Washington
J. C. McDougall
520 First Avenue, So.
Seattle 4, Washington
Main 7667

Federal Screw Products Inc., 3917 N. Kedzie Ave., Chicago 18, Ill. IRving 8-5744
(See advertisement on page 196)

Federal Shock Mount Corp., Div. of Korfund Co., Inc., 1060 Washington Ave., New York 56, N. Y. WY 3-6400

Feedback Controls, Inc., 899 Main St., Waltham 54, Mass. TWinbrook 4-1020

Feller Engrg. & Mfg. Co., 8026 No. Monticello, Skokie, Ill. COrnelia 7-8280

Fellows Gear Shaper Co., 78 River St., Springfield, Vt. TUrner 8-2131

Femco, Inc., P. O. Box 32, Irwin, Pa. UNderhill 3-2200

Fenwal Inc., Pleasant St., Ashland, Mass. TRinity 5-6111

Ferguson Company, 814 Ridgely St., Baltimore 30, Md. LExington 9-5202

Ferguson Hille & Assoc. Inc., 542 S. Dearborn St., Chicago 5, Ill. WA 2-1808

Ferranti Electric, Inc., 95 Madison Ave., Hempstead, N. Y. IVanhoe 3-8244

Film Capacitors, Inc., 3400 Park Ave., New York 56, N. Y. CYpress 2-5180

Filtors, Inc., 89 Sagamore Hill Drive, Port Washington, N. Y. Port Washington 7-8230

Dallas Representatives
Allied Components Inc.
2517 Converse St., Dallas 7, Texas
RIverside 2-2830

Fischer & Porter Co., 775 County Line Rd., Hatboro, Pa. OSborne 5-6000

Fisher Co., Inc., Oscar., P. O. Box 436, Newburgh, N. Y. NEwburgh 2-3900

Fisher Governor Co., Box 307, Marshalltown, Iowa. Telephone 753
(See advertisement on pages 14, 15)

Representative—So. California Area
S. N. Jones & Company
2334 W. 8th St., Los Angeles 21, Calif.
MAdison 7-1667

North Carolina Representative
Pobt. E. Mason & Co.,
1726 Hutchison Ave., Charlotte, N. C.
FRanklin 5-3747

Fisher Scientific Co., 711 Forbes Ave., Pittsburgh 19, Pa. EXpress 1-1300

Fish-Schurman Corp., 70 Portman Road, New Rochelle, N. Y. NE 6-1300
(See advertisement on page 164)

Fleetwood Laboratories, Inc., 300 Victory Blvd., New Rochelle, N. Y. BEverly 5-0931

Flexaust Co., 100 Park Ave., New York 17, N. Y. ORegon 9-1300

Flexonics Corp., 1337 S. 3rd Ave., Maywood, Ill.

Flodar Corp., 16911 St. Clair Ave., Cleveland 10, Ohio IV-6-2200

Flow Corp., 85 Mystic St., Arlington 74, Mass. MIssion 8-8125

Flow Measurements Corp., 10506 Wheatley St., Kensington, Md. LO 4-0122

Fluke Mfg. Co., Inc., John., 1111 West Nickerson, Seattle 99, Wash.

Fox Valley Instrument Co., Route 1, Cheboygan, Mich. MAdison 7-8181

Foxboro Co., 38 Neponset Ave., Foxboro, Mass. CApitol 7-1260

Freed Transformer Co., Inc., 1718 Weirfield St., Brooklyn 27, N. Y. EVergreen 6-1300
(See advertisement on page 94)

Friden, Inc., 2350 Washington Ave., San Leandro, Calif.

Fuller Co., 124 Bridge St., Catasauqua, Pa. COngress 4-2841

Fulton Sylphon Div., Robertshaw-Fulton Controls Co., P. O. Box 400, Knoxville 1, Tenn. Telephone 4-1641
(See advertisement on page 64)

Furnas Electric Co., 1000 McKee St., Batavia, Ill. BAtavia 3410

G

GPE Controls, Inc., 240 E. Ontario St., Chicago 11, Ill. WHitehall 4-3700

BIRMINGHAM 9, ALABAMA
McConnell Sales & Engineering Corp.
P.O. Box 5708—Homewood Branch
1661-28th Ave. S. TRemont 1-3501

BUFFALO, NEW YORK
GPE Controls, Inc., (R. E. Tuwalski)
Room 808—The Rand Building
14 Lafayette Square. MOhawk 0997

BURBANK, CALIFORNIA
GPE Controls, Inc.
40 East Verdugo Ave. THornwall 5-1784

CHICAGO 11, ILLINOIS
GPE Controls, Inc. (F. J. Markey)
240 East Ontario St. WHitehall 4-3700

CINCINNATI 15, OHIO
Harry T. Porter Company
Box 246—Lockland Branch. VAlley 1-4346

CLEVELAND 15, OHIO
GPE Controls, Inc. (T. W. Lasiewicz)
Room 425—Union Building
1836 Euclid Ave. CHerry 1-1633

DALLAS 6, TEXAS
Wright Industrial Products Co.
5738 N. Central Expressway. TAylor 4-2571

DENVER 16, COLORADO
Howard Peterson Company
4949 Colorado Blvd. DExter 3-5434

DETROIT 35, MICHIGAN
GPE Controls, Inc. (William S. Hultz)
20131 James Cousens Hwy. VErmont 8-8683

GREENVILLE, SOUTH CAROLINA
Marshall & Williams Equipment Co.
(Textile Industry Only)
Box 5285—Sta. B. CEdar 2-7338

HOUSTON 19, TEXAS
The Eads Company
Box 12071, 1118 Dunlavy St. JAckson 6-1646-7

KANSAS CITY 12, MISSOURI
W. C. Carolan Company
612 West 47th St. JEfferson 1-5505

KENNER, LOUISIANA
E. C. Deshautreaux, Jr.
P.O. Box 261. KEnner (21) 4-4665

LOS ANGELES 22, CALIFORNIA
Bojanower Machinery Service Co.
(Edge position control activity only exclusive of primary steel plants)
5270 E. Washington Blvd. ANgelus 3-6175

NEW YORK, NEW YORK
GPE Controls, Inc. (T. G. Watkins)
175 Market St., Paterson 1, N. J. LAmbert 5-0561

PITTSBURGH 22, PENNSYLVANIA
GPE Controls, Inc. (E. R. Engstrom)
618 Bessemer Bldg., 104-6th St. GRant 1-7085

SALT LAKE CITY 1, UTAH
Specialty Sales Company
117 West 2nd South St. DAvis 2-5553

CANADA
Process-Instrument Systems, Ltd.
44 Haas Road. Toronto (Rexdale P.O.) Ont.
CHerry 1-4401

GPS Instrument Co., Inc., 180 Needham St., Newton 64, Mass. DEcatur 2-8110

G. S. Equipment Co., 15585 Brookpark Rd., Cleveland 35, Ohio. CLearwater 2-4770
(See advertisement on page 33)

G-V Controls Inc., Okner Parkway, Livingston, N. J. WYman 2-6200

Gaertner Scientific Corp., 1208 Wrightwood Ave., Chicago 14, Ill.

Gallien & Son, R. P., 220 West Fifth St., Los Angeles 13, Calif.
(See advertisement on page 157)

Gamewell Company, 1238 Chestnut St., Newton Upper Falls 64, Mass. BIgelow 4-1240

Gap Instrument Corp., 116 E. Merrick Rd., Freeport, L. I., N. Y. FReeport 8-1046

Garde Mfg. Co., 53 John St., Cumberland, R. I. Pawtucket 6-4300

Garlock Packing Co., 402 Main St., Palmyra, N. Y.

Garlynn Engineering Co., 755 Pennsylvania Ave., San Francisco 7, Calif. MIssion 7-2113

Gas Drying, Inc., Box 56, Summit, N. J. CRestview 3-0622

Gates & Co., Geo. W., Hempstead Tpke. & Lucille Ave., Franklin Square, L. I., N. Y. FIeldstone 7-0787, -8, -9

Gates Electronic Co., 2090 Barnes Ave., Bronx 60, N. Y. TYrone 2-6490

Gatti, Inc., Aurele M., 527 Tindall Ave., Trenton 9, N. J. EXport 6-1577

Gaynes Engineering Co., 1642 W. Fulton St., Chicago 12, Ill. HA 1-5257

Geier & Bluhm, Inc., 594 River St., Troy, N. Y. AShley 2-6951
(See advertisement on page 141)

Gelber & Sons, S., Inc., 5806 N. Lincoln Ave., Chicago 45, Ill. LO 1-3787

Gelman Instrument Co., 106 N. Main St., Chelsea, Mich. GReenwood 9-4821
(See advertisement on page 120)

Gems Co., Inc., 85 Market Sq., Newington, Conn.
California Representative
Carkeek Engineering Co.
285 S. Euclid Ave., Pasadena, Calif.
MUrray 1-0489

General Automatic Corp., 12 Carlton Ave., Mountain View, N. Y. CL 6-3756

General Cement Mfg. Co., Div. of Textron Inc., 400 So. Wyman St., Rockford, Ill. WOodland 8-9661

General Controls Co., 801 Allen Ave., Glendale 1, Calif. Victoria 9-2181
(See advertisement on Back Cover)

General Controls Co., PIC Automation Controls Div., 8080 McCormick Blvd., Skokie, Ill.
Detroit Representative
The Basle Service Corp.
18544 Plymouth Rd., Detroit, Mich.
VErmont 7-2820

General Devices, Inc., P. O. Box 253, Princeton, N. J. DA 9-2323
Massachusetts Representative
George J. Neuman & Co.
104 Pilgrim Rd., Wellesley 81, Mass.
CEdar 5-8353

General Electric (GE) Co., Apparatus Sales Div., 1 River Road, Schenectady 5, N. Y. FRanklin 4-2211
(See advertisement on pages 59, 109, 132, 163)

General Electric (GE) Co., Capacitor Department, Irmo, S. C.
Authorized Factory Source
Schweber Electronics
60 Herricks Rd., Mineola, L. I., N. Y.
PIoneer 6-6520

General Electric (GE) Co., Computer Dept., Deer Valley Park, Phoenix, Ariz.

General Electric (GE) Co., Heavy Military Electronics Dept., Court Street Plant, Syracuse, N. Y. GRanite 4-4411

General Electric (GE) Co., Magnetic Materials Section, Edmore, Mich. HA-7-5151

General Electric (GE) Co., Missile & Space Vehicle Dept., Lakeside Ave., Burlington, Vt. UNiversity 3-3411

General Electric (GE) Co., Power Tube Dept., 1 River Road, Bldg. 267, Schenectady 5, N. Y. FRanklin 4-2211

General Electric (GE) Co., Semiconductor Products Dept., 1224 W. Genesee St., Syracuse, N. Y.

General Electric (GE) Co., Specialty Controls Dept., Waynesboro, Va.
Authorized Factory Source
Schweber Electronics
60 Herricks Rd., Mineola, L. I., N. Y.
PIoneer 6-6520

General Electric (GE) Co., Voltage Regulator Product Section, 100 Woodlawn Ave., Pittsfield, Mass.

General Electric (GE) Co., X-Ray Dept., 4855 Electric Ave., Milwaukee 1, Wis. EVergreen 3-3211

General Electrodynamics Corp., 4430 Forest Lane, Garland, Texas. BRoadway 6-1161

General Industries Co., Olive and Taylor Sts., Elyria, O. FAirfax 3-8156

General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J. PI 8-2400

General Meters, Inc., 424 South 7th St., P. O. Box 1701, Grand Junction, Colo.
(See advertisement on page 93)

General Mills, Inc., Mechanical Div., 1620 Central Ave. N.E., Minneapolis 13, Minn. STerling 9-8811

General Photo Prods. Co., Inc., P. O. Box 23, Chatham, N. J. MErcury 5-5200

General Precision Laboratory, Inc., 63 Bedford Road, Pleasantville, N. Y. ROgers 9-5000

General Radio Co., West Concord, Mass. EMerson 9-4400
(See advertisement on page 91)

General Railway Signal Co., P. O. Box 600, Rochester 2, N. Y. IDlewood 6 3020

General Regulator Corp., 666 5th Ave., New York 19, N. Y. JU 2-6600

General Resistance, Inc., 577 E. 156th St., Bronx 55, N. Y. CY-2-1500

General Time Central Research Laboratory, 107 Lafayette St., N. Y. 13, N. Y. WOrth 6-0822
(See advertisement on page 78)

General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y. HI 1-1000

Genesys Corp., 10131 National Blvd., Los Angeles 34, Calif. TExas 0-2777

Genisco, Inc., 2233 Federal Ave., Los Angeles 64, Calif. BRadshaw 2-2706

Genisco Instrument Div., Genisco, Inc., 2209 Barry Ave., Los Angeles 64, Calif. GR 9-4331 Ext. 66

Geotechnical Corp., 3401 Shiloh Road, Garland, Texas. BRoadway 8-8102
(See advertisement on page 131)

Gerber Scientific Instrument Co., 89 Spruce St., Hartford 1, Conn. JAckson 8-2124

Giannini Controls Corp., 918 E. Green St., Pasadena, Calif. MUrray 1-7182

Gibson Electric Co., Box 540, Delmont, Pa. HOward 8-7701

Gilmore Industries, 13015 Woodland Ave., Cleveland 20, Ohio. RA 1-6400

Gisholt Machine Co., 1331 East Washington Ave., Madison 10, Wis. ALpine 6-9081

Gleason Works, 1000 University Ave., Rochester 3, N. Y. GReenfield 3-1000

Globe Electrical Mfg. Co., 1729-45 W. 134th St., Gardena, Calif. FAculty 1-3311

Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio. BA 2-3741

Golden Anderson Valve Specialty Co., Inc., 1232 Ridge Ave., Pittsburgh 33, Pa. FAirfax 2-8130
(See advertisement on page 72)

Gombos Co., John, Webro Road, Clifton, N. J. PRescott 3-6633

Gordon Co., Claud S., 3000 S. Wallace St., Chicago 16, Ill. VIctory 2-6525
St. Louis Representative
Fiite Sales & Engineering Co.
4401 Chouteau Ave., St. Louis, Mo.
JEfferson 1-0477

Gordon Enterprises, 5362 No. Cahuenga Blvd., No. Hollywood, Calif. POplar 6-3725

Gordos Corp., 250 Glenwood Ave., Bloomfield, N. J. PIlgrim 3-6800

Gorham Mfg. Co., Electronics Div., 333 Adelaide Ave., Providence 7, R. I. Williams 1-1000

Gorn Electric Co., Dept. IA, 845 Main St., Stamford, Conn. FIreside 8-7591

Gorton Machine Co., Geo., 1126 W. 13th St., Racine, Wis. MElrose 4-6644

Goslin Electric & Mfg. Co., 2921 W. Olive Ave., Burbank, Calif. THornwall 8-0776

Gould Co., J. D., 4707 Massachusetts Ave., Indianapolis 18, Ind. LIberty 7-5389

Gow-Mac Instrument Co., 100 Kings Road, Madison 1, N. J. FRontier 7-3450
(See advertisement on page 120)

Graf-Apsco Co., 5368 Broadway, Chicago 40, Ill. LOngbeach 1-6085

Graham Transmissions, Inc., Menomonee Falls, Wis. MEnomonee Falls 3600

Grain Laboratory Equip., Inc., Longlake, Minn. GR 8-8400

Grant Pulley & Hardware Corp., High St., West Nyack, N. Y. NYack 9-4400

Granville-Phillips Co., P. O. Box 191, Pullman, Wash. LOgan 41130

Graphic Controls Corporation, Buffalo 10, New York
(See advertisement on page 146)

Graphik-Circuits Div., Cinch Mfg. Co., 200 So. Turnbull Canyon Road, City of Industry, Calif. EDgewood 3-1901

Graphite Metallizing Corp., 1096 Nepperhan Ave., Yonkers, N. Y. YOnkers 8-8400

Gray Instrument Co., 448 Mill Rd., Andalusia, Pa. HO 4-2100
(See advertisement on pages 96, 172)

Grayhill Inc., 561 Hillgrove Ave., LaGrange, Ill. FLeetwood 4-1040

Green Instrument Co., Inc., 385 Putnam Ave., Cambridge 39, Mass. ELiot 4-2989
(See advertisement on page 191)

Green Instruments, Henry J., Inc., 2501 Shames Drive, Westbury, N. Y. EDgewood 3-5888

Green Rectifier Co., 1-10 30th St., Fairlawn, N. J. SWarthmore 7-8100

Greibach Instruments Corp., 315 North Ave., New Rochelle, N. Y. New Rochelle 3-7900

Greiner Co., Emil, 20 N. Moore St., New York 13, N. Y. WO-6-4700

Griebel Co., E., P. O. Box 354, Carbondale, Pa. Telephone 153

Gries Reproducer Corp., 130 Beechwood St., New Rochelle, N. Y. NE 3-8800

Grinnell Co., 277 West Exchange St., Providence 1, R. I. TEmple 1-7000

Grove Valve & Regulator Co., 6529 Hollis St., Oakland 8, Calif. OL 5-7700
(See advertisement on page 51)

Gubelman Charts, Inc., 100-106 E. Kinney St., Newark 5, N. J. Mitchell 2-5970
(See advertisement on page 157)

Gudeman Co., 340 W. Huron St., Chicago 10, Ill. DElaware 7-7400

Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J. LIberty 8-8200

Gump Co., B. F., 1325 S. Cicero Ave., Chicago 50, Ill. BI 2-3050

Gurley, W. & L. E., 1900 Fifth Ave., Troy, N. Y. ASbley 2-6300

Gustafson Mfg. Co., G. D., 29 E. Madison St., #1409 Chicago 2, Ill. STate 2-1341
(See advertisement on page 207)

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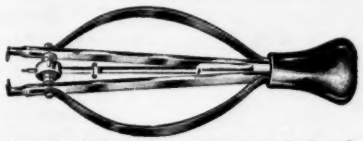

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CIRCLE 387 ON READER-SERVICE CARD

Guthery Machine Tool Corp., 38-31 Crescent St., Long Island City 1, New York
(See advertisement on page 192)

Gyrex Corp., 3003 Pennsylvania Ave., Santa Monica, Calif. EXbrook 30462

H

H-B Instrument Co., American & Bristol Sts., Philadelphia 40, Pa. DA 9-9125

H & H Machine Co., Inc., Noble & Jackson St., Norristown, Pa. BRoadway 2-6453

H. J. J. Company, 268 Marlow Drive, Oakland 5, Calif. LOckhaven 2-1603
(See advertisement on page 193)

Hagan Chemicals & Controls, Inc., Hagan Bldg., Pittsburgh 30, Pa. WAlnut 2-3737
(See advertisement on pages 30, 31, 32, 38, 46, 50, 57, 63, 79, 96, 162)

Haledy Electronics Co., 57 William St., New York 5, N. Y. WHitehall 3-3140

Hallikainen Instruments, 1341-7th St., Berkeley 10, Calif. LAndscape 4-1757

Haloid-Zerox, Inc., 57-198X Haloid St., Rochester 3, N. Y.

Hamilton Tool Co., 9th St. at Hanover, Hamilton, Ohio TWinbrook 5-4351

Hamilton Watch Co., Industrial Div., Columbia Ave., Lancaster, Pa. EXpress 4-7161

Hamlin, Inc., 1316 Sherman Ave., Evanston, Ill. Greenleaf 5-8244

Hammel-Dahl Div., General Controls Co., Warwick Industrial Park, Warwick, R. I. STuart 1-6200

Hamner Electronics Co., Inc., P.O. Box 531, Princeton, N. J. Pennington 7-1320

Handicraft Tools, Inc., Div. of X-Acto, Inc., 48-41 Van Dam St., Long Island City 1, N. Y. EXeter 2-3333

Handy & Harman, 82 Fulton St., New York 38, N. Y.

Hankison Corp., Dept. CI, College & Pike, Cannonsburg, Pa. LOcust 3-3337
(See advertisement on page 30)

Hansen Co., Wm., 165 Silverbrook Ave., Niles, Mich.

Hanson-Gorrill-Brian, Inc., 85 Hazel St., Glen Cove, N. Y. Oriole 6-7300

Harco Laboratories, Inc., 77 Olive, New Haven 7, Conn. STate 7-6701

Hardwick, Hindle, Inc., 40 Hermon St., Newark 5, N. J. MArket 2-8200

Harris Refrigeration Co., 308 River St., Cambridge 39, Mass. UNiversity 4-4000

Harris Transducer Corp., Woodbury, Conn. COngress 3-2116

Hart Manufacturing Co., 220 Bartholomew Ave., Hartford 1, Conn. JAckson 5-3491

Hartford Steel Ball Co., Inc., 12 Jefferson Ave., West Hartford, Conn. AD-3-1251

Harvey-Wells Electronics, Inc. R&D Div., 5168 Washington St., West Roxbury 32, Mass. FAirview 7-8000

Haskris Co., 6720 N. Lincoln Ave., Lincolnwood, (Chicago 45), Ill. COrnelia 7-3211

Hasler-Tel. Co., Inc., 30 Vesey St., New York 7, N. Y. WOrth 2-2831
(See advertisement on page 61)

Hass Instrument Corp., 6173 Branch Ave., Washington, 23 D. C. HI 9-5454
(See advertisement on page 44)

Hassall, Inc., P. O. Box 2158, Westbury, Long Island, N. Y.
(See advertisement on page 195)

Hasting-Raydist, Inc., Newcomb Ave., Hampton, Va. PArk 3-6531
Rep—Pittsburgh, Pa., Charleston, W. Va.
Kurt J. Lesker Company
4535 Veman Ave., Pittsburgh 27, Pa.
TUxedo 1-4666

Philadelphia Area Representative
Tyler Griffin Company
32 S. Fairfield Rd., Devon, Penna.
MUrray 8-4821 and ENterprise 9-4821

Hathaway Instrument Div., Hamilton Watch Co., 5800 E. Jewell, Denver 22, Colo. SKyline 6-8301

Haveg Industries, Inc., 900 Greenbank Rd., Wilmington 8, Del. WYman 8-2271

Hawk Tool & Engrg. Co., Inc., Clarkston, Mich. MA 5-5381

Haydon Co., A. W., 228 No. Elm St., Waterbury 20, Conn. PLaza 6-4481
(See advertisement on page 26)

Haydon Div., General Time Corp., 245 E. Elm St., Torrington, Conn. HUnter 9-3158

Haydon Instrument Co., 165 W. Liberty St., Waterbury 20, Conn. PLaza 6-2211

Haydon Switch, Inc., 536 So. Leonard St., Waterbury 20, Conn. PLaza 6-7441

Hayes, Inc., C. I., 800 Wellington Ave., Cranston 10, R. I. HOpkins 1-3400

Hays Corp., Michigan City 39, Ind. TRiangle 2-5561

Hays Manufacturing Co., Automatic Controls Div., 801 W. 12th St., Erie, Pa. Telephone 2-3225

Healy-Ruff Co., 2255 University Ave., St. Paul 14, Minn. MIdway 6-2701

Heinze Electric Co., 685 Lawrence St., Lowell, Mass. GL 77556

Heise Bourdon Tube Co., Inc., Brook Road, Newtown, Conn. GArden 64406
(See advertisement on page 53)

Heitz, Inc., Karl, 480 Lexington Ave., New York 23, N. Y. YUkon 6-4920
(See advertisement on page 78)

Helicoid Gage Div., American Chain & Cable Co., Inc. 929 Connecticut Ave., Bridgeport 2, Conn. Edison 5-0161

Heller Co., Gerald K., 1819 Industrial Road, P.O. Box 4428, Las Vegas, Nev.

Henry Valve Co., 3215 North Ave., Melrose Park, Ill. FIlmore 4-1100

Henson Co., Fred C., 3311 E. Colorado Blvd., Pasadenna 8, Calif. SY-2-3311

Hermes Electronics Co., 75 Cambridge Parkway, Cambridge 42, Mass.
New England Representative
Instrument Dynamics, Inc.
11Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Herron Optical Co., 9117, S. Main St., Los Angeles 3, Calif. PLymouth 4-2943

Hevi-Duty Electric Co., 2040 W. Wisconsin Ave., Milwaukee 1, Wis. WE 3-9339

Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif. DAvenport 5-4451

Hewson Co., Inc., 443 Broad St., Newark 2, N. J. HUmboldt 3-3000

Hexacon Electric Co., 161 W. Clay Ave., Roselle Park, N. J. Chestnut 5-6200

Hiekok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio. LIberty 1-8060
(See advertisement on page 107)

SALES REPRESENTATIVES

New England
Johnson Associates—CRystal 6-5500
404 Main St., Wakefield, Mass.

D. C., Virginia, Maryland
G. E. Wolfe—EXecutive 3-2692
Box 9812, Rosslyn Sta., Arlington 9, Va.

N. & S. Car., Tenn., Ga., Ala., Fla.
Hollingsworth & Still—MUrray 8-5878
508 Whitehead Bldg., Atlanta, Ga.
Hollingsworth & Still—GArden 5-6803
807 N. Summerlin St., Orlando, Fla.

Hollingsworth & Still—Plaza 7-9793
7290 N.E. 8th Ave., Miami, Fla.
Hollingsworth & Still—JAckson 3-2966
4837 Gilmore Dr., Charlotte, N. C.

N. Y. City, N. J., Eastern Penna.
K. E. Hughes Co.—UNion 7-3204
4808 Bergenline Ave., Union City, N. J.
K. E. Hughes Co.—EVergreen 6-3130
101 N. 33rd St., Philadelphia, Penna.
R. K. Arbogast—NOrth 4-5656
257 Ell Rd., Hillsdale, N. J.
Howard N. Jurnovoy—GReenwood 3-1417
5704 Malvern Ave., Philadelphia, Penna.

Upper N. Y. State, Erie, Penna.
R. W. Mitscher Co.—WAshington 2517
487 Ellicott Sq. Bldg., Buffalo 3, N. Y.
R. W. Mitscher Co.—GIbson 6-3164 (Syracuse)
51 Ely Dr., Fayetteville, N. Y.
R. W. Mitscher Co.—GLobe 4-8320
15 Thornwood Dr., Poughkeepsie, N. Y.
R. W. Mitscher Co.—HUbbard 7171 (Rochester)
786 Chestnut Bend, Webster, N. Y.

Ohio, Ky., W. Va., W. Pa., S. Ind.
James M. Landfear & Co.—FAirmont 1-4533
12429 Cedar Rd., Cleveland 6, Ohio
Fishman Associates—LIberty 6-5477
4440 N. Campbell Ave., Indianapolis 26, Ind.

Michigan, Northern Indiana
George Harbough—JUniper 8-0187
144 Wacon, Troy, Mich.

Mississippi, S. Louisiana
Earl K. Moore Co.—AUdubon 2407
5864 Louisville, New Orleans 24, La.

N. Dak., S. Dak., Wis., Minn., N. Iowa
Nick J. Laub Co.—JUniper 8-4663
3749 W. Broadway, Minneapolis 22, Minn.
Nick J. Laub Co.—DIvision 4-2200
2333 West Wells St., Milwaukee, Wis.

Northern Illinois, S. Wisconsin
L. C. McCarthy—KIldare 5-7976
7117 W. Addison St., Chicago 34, Ill.

Nebr., Kan., Mo., S. Iowa, S. Ill.
G. Kangas Sales Co.—TUxedo 8-5213
10506 W. 89th St., Overland Park, Kan.

Texas, Okla., Ark., N. La.
J. Earl Smith—FLeetwood 7-1727
Box 35331 Airlawn Sta., Dallas 35, Tex.
J. Earl Smith—MIssion 4-4621
5339 Keystone, Houston 21, Tex.

Wyo., Colo., Utah, New Mexico
Gordon Moss Electronics, Inc.—ELgin 3-1452
1530 13th Ave., P.O. Box 428, Greeley, Colo.
Gordon Moss Electronics, Inc.—GLendale 5-0268
5194 Perry St., Denver, Colo.

West Coast, Pacific Northwest
Branch Office—THornwall 5-1771
2585 Shattuck Ave., Berkeley 4, Calif.
Branch Office—HOllywood 7-7672
P.O. Box 1187, Hollywood 28, Calif.
Emery C. Boring—ALpine 3-9472
13128 S.E. Ash St., Portland 16, Ore.

Canada
Stark Electronic Sales—AJax 125
P.O. Box 670, Ajax, Ontario

Export
Hickok Export Dept.—MUrrayhill 3-2400
431 Fifth Ave., New York 16, N. Y.

Hawaii
Gene Piety Factors, Inc.—Phone 83-105
2030 Home Rule St., Honolulu, Hawaii

High Temperature Instruments Corp., 143 Bala Ave., Bala-Cynwyd, Pa. MOhawk 4-5985

Hill & Co., E. Vernon, P.O. Box 189, Lake Geneva, Wis. CHestnut 8-3729

Hillburn Electronic Prods. Co., 55 Nassau Ave., Brooklyn 22, N. Y. STag 2-3875

Hills-McCanna Co., 4595 W. Touhy Ave., Chicago 46, Ill. ORchard 4-7080

Hirschmann Co., Carl, Inc., 30 Park Ave., Manhasset, L. I., N. Y. MAnhasset 7-5300

Hitemp Wires, Inc., 1200 Shames Drive, Westbury, L. I., N. Y. ED 3-4C90

Hobbs Corp., John W., Div. Stewart-Warner Corp., P.O. Box 358, Springfield, Ill. Telephone 8-7533

Hoffman Electronics Corp., Semiconductor Div., 930 Pitner Ave., Evanston, Ill. UNiversity 9-9850

Hoffman Laboratories Div., Hoffman Electronics Corp., 3740 So. Grand Ave., Los Angeles 7, Calif. RIchwood 7-4488

Heke, Inc., 1 Tenakill Park, Cresskill, N. J. LOwell 8-9100
(See advertisement on page 48)

Rep—Pittsburgh, Pa., Charleston, W. Va.
Fogleman Co., Inc.
3849 Willow Ave., Pittsburgh 34, Pa. LE-1-4005
510 "C" St., S. Charleston 3, W. Va. RI-4-8401

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Holtzer-Cabot Div., National Pneumatic Co., Inc., 125 Amory St., Boston 19, Mass. JAmaica 4-7000

Hoover Electronics Co., 110 W. Timonium Rd., Timonium, Md. VAlley 5-5200

Houston Instrument Corp., 1717 Clay Ave., Houston 3, Tex. CApitol 5-6964
(See advertisement on page 115)

HOUSTON INSTRUMENT REPS.

CALIFORNIA, ARIZONA, NEVADA
McCarthy Associates, Inc.
1055 E. Walnut, Pasadena. MU-1-7411
3460 Ingraham, San Diego. BR-4-1100
Sacramento-Folsom: ENterprise 1-0879
635 Oak Grove, Menlo Park. DA-6-7937
111 W. Osborn Rd., Phoenix. CR-9-1891

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J. L. Highsmith & Co.
3733 Monroe Rd., Charlotte, N. C.
FRanklin 7-2546

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CL-9-2311

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J. L. Peirce Company
16666 James Couzens Hwy., Detroit 21.
UNiversity 2-2571

NEW ENGLAND
J. M. Lancaster Company
7 Barker Lane, Saxonville, Mass.
TRinity 3-8893

OHIO
Elliott-Sarles Company
23473 Concord Dr., Westlake.
EDison 1-8911

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Q E D Electronic Sales, Inc.
9 Elm Ave., Mount Vernon, N. Y.
MOunt Vernon 8-3100

MD., D. C., DELAWARE & NO. VIRGINA
Thos. H. Closs Co.
21 W. Penna. Ave., Towson 4, Md.

Houston Magnetic Products, Inc. (Subsidiary of Houston Instr. Corp.), 1514 Foley St., Houston 24, Tex. HOmestead 8-2696
(See advertisement on page 86)

Hoyt Electrical Instrument Works, see Burton-Rogers Co.

Hub-Pot, Inc., 13827 Saticoy St., Van Nuys, Calif. STate 2-2300

Hufco Industries, 2815 W. Olive Ave., Burbank, Calif. VIctoria 9-2118

Hughes Products, International Airport Sta., Los Angeles 45, Calif. ORchard 0-1515

Humphrey, Inc., 2805 Canon St., San Diego 6, Calif. AC-31654

Humphrey Products Div., General Gas Light Co., 202 N. Park St., Kalamazoo, Mich. FI 2-0127

Hunter Spring Co., 1 Spring Ave., Lansdale, Pa. Ulysses 5-6815

Huppert Co., K. H., 6830-40 Cottage Grove, Chicago 37, Ill. MI 3-4770

Hurst Tool & Mfg. Co., Inc., Hwy 64 East, Princeton, Ind.

Hydraulic Controls Co., Inc., 217 California St., Newton 58, Mass. DEcatur 2-0066

Hydromatics Inc., 70 Okner Pkwy., Livingston, N. J. WYman 2-4900

Hydroway Scales, Inc., 31302 Stephenson Hwy., Madison Heights, Mich. JOrdon 6-3965

Hydel, Inc., 223 Crescent St., Waltham 54, Mass. TWinbrook 3-8200

I

IBM (International Business Machines Corp.), 590 Madison Ave., New York 22, N. Y. PLaza 3-1900

Ideal Industries, Inc., 1420 Park Ave., Sycamore, Ill. Telephone 2114

Ideal Precision Meter Co., Inc., 126 Greenpoint Ave., Brooklyn 22, N. Y. EV 3-6904

Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill. WHitehall 3-1331
(See advertisement on page 22)

Illumitronic Engineering Co., 680 E. Taylor Ave., Sunnyvale, Calif.
(See advertisement on page 194)

Impact-O-Graph Corp., 1900 Euclid Ave., Cleveland 15, Ohio CHerry 15838

Imperial Brass Manufacturing Co., 6300 W. Howard St., Chicago 48, Ill SPring 4-1700
(See advertisement on page 23)

Indiana Steel Products Co., 405 Elm St., Valparaiso, Ind. Telephone 2-5601
(See advertisement on page 167)

Induction Motors Corp., 570 Main St., Westbury, N. Y. EDgewood 4-7070

Induction Motors of Calif., Div. of Induction Motors Corp., 6058 Walker Ave., Maywood, Calif. LUdlow 3-4785
(See advertisement on page 78)

Industrial Engineering Corp., 525 E. Woodbine, Louisville 8, Ky. MElrose 4-3601
(See advertisement on page 52)

Industrial Instrument Corp., Drawer 777, Austin, Texas GLendale 3-7261

Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, Essex County, N. J. CEnter 9-6200
(See advertisement on pages 30, 43, 95, 96, 101, 105, 126, 159)

Industrial Instruments Engineering Corp., 89 Commerce Rd., Cedar Grove, Essex County, N. J.
(See advertisement on pages 40, 158)

Industrial Measurements Corp., 250 N. Thomas St., Pomona, Calif. NAtional 3-1588

Industrial Nucleonics Corp., 650 Ackerman Rd., Columbus 14, Ohio. AMherst 7-6351

Industrial Rectifier Devices, Inc., 324 Lafayette St., New York 12, N. Y. WOrth 4-4960

Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y. GRamercy 3-4684
(See advertisement on page 108)

Industrial Timer Corp., 1407 McCarter Highway, Newark 4, N. J. HU 4-5600

Industrial Transformer Corp., Gouldsboro, Pa. VIctor 22111

Industro Transistor Corp., 35-10-36th Ave., Long Island City 6, N. Y. EXeter 2-8000

Inertia Switch Inc., 311 W. 43rd St., New York 36, N. Y. JUdson 6-5880

Infilco, Inc., 901 S. Campbell, Tucson, Ariz. MAin 3-5401

Infrared Industries, Inc., 62-4th Ave., Waltham 54, Mass. TWinbrook 3-5400

Insco Co., Div. of Barry Controls, Inc., Hollis St., Groton, Mass. Gilbert 8-6358

Instrol Inc., 135E. De la Guerra St., Santa Barbara, Calif. WOodland 51691

Instron Engineering Corp., 2500 Washington St., Canton, Mass. CAnton 6-2500

Instrulab, Inc., 1205 Lamar St., Dayton 4, Ohio BA-3-2241
(See advertisement on page 209)

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Instrument Development Co., 1019 Emerson Ave., Salt Lake City, 5, Utah. IN 6-4285

Instrument Development Laboratories, Inc., 67 Mechanic St., Attleboro, Mass. ATtleboro 1-3880

Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill. MI 2-0123

Instrument Mirror Co., Div. Houston Instr. Corp., 1514 Foley St., Houston 24, Tex. HOmestead 8-2696
(See advertisement on page 169)

Instruments, Inc., 3102 Sand Springs Rd., Tulsa, Okla. CH 24151

Intercontinental Electronics Corp., 1551 Franklin Ave., Mineola, N. Y. PIoneer 6-5010

Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y. Ludlow 4-6200
(See advertisement on page 159)

International Electronic Research Corp., 145 W. Magnolia Blvd., Burbank, Calif. Victoria 9-2481

International Instrument Co., Canyon, Calif. DRake 6-4673

International Radiant Corp., 111 New York Ave., Westbury, L. I., N. Y. EDgewood 4-8820

International Rectifier Corp., 233 Kansas St., El Segundo, Calif. ORegon 8-6281
(See advertisement on page 151)

International Register Co., Instrument Div., 2630 W. Washington Blvd., Chicago 12, Ill. VAn Buren 6-4242
(See advertisement on page 51)

International Research & Development Corp., 6150 Huntley Rd., Worthington, Ohio TUexdo 5-5376

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. WA 2-2166 Ext. 310

Ipsen Industries, Inc., 715 So. Main St., Rockford, Ill. WOodland 5-9581

Iron Fireman Mfg. Co., Electronics Div., 2838 S.E. 9th Ave., Portland 2, Oregon BEImont 4-6551

Isotopes Specialties Co., Div. of Nuclear Corp. of America, 170 W. Providencia, Burbank, Calif. VI 9-2273

Itemco, Inc., P. O. Box 191, Port Washington, N. Y. POrt Washington 7-8330
(See advertisement on page 19)

J

J-B-T Instruments, Inc., New Haven 8, Conn.
(See advertisement on pages 102, 103)

JFD Electronics Corp., 6101-16th Ave., Brooklyn 2, N. Y. DEwey 1-1000

J-V-M Microwave Co., 9300 W. 4th St., Brookfield, Ill.
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Jaegers Optical Corp., 692 Merrick Road, Lynbrook, New York
(See advertisement on page 169)

Jaidinger Mfg. Co., Inc., 1921 W. Hubbard St., Chicago 22, Ill.
(See advertisement on page 172)

James Vibrapowr Co., 4050 N. Rockwell St., Chicago 18, Ill. CO 7-6333

Jamesbury Corp., 115 New St., Worcester, Mass.

Jan Hardware Mfg. Co., Inc., 38-01 Queens Blvd., Long Island City 1, New York EMpire 1-0800

Jarrell Ash Co., 26 Farwell St., Newtonville 60, Mass. DEcatur 2-2130

Jeffrey Mfg. Co., 797 No. 4th St., Columbus 16, Ohio

Jennings Radio Mfg. Corp., 970 McLaughlin Ave., San Jose 8, Calif. CYpress 2-4025

Jergusen Gage & Valve Co., 100 Adams St., Burlington, Mass.
(See advertisment on page 42)

Jensen Tool Co., H. C., 16 Mechanic St., Waltham 54, Mass. TW 3-7940

Jerber Engineering Co., 2334 Secane Rd., Secane, Pa.

Jo-Bell Products, Inc., 5456 W. 111th St., Oak Lawn, Ill. GArden 5-0240

Johanson Mfg. Corp., P. O. Box 329, Boonton, N. J. DEerfield 4-2676

Johnson Corp., 805 Wood St., Three Rivers, Mich. Telephone 21715

Johnson Engrg. Co., Welton V., Inc., 95 Summit Ave., Summit, N. J. CRestview 7-4200
(See advertisement on page 192)

Johnson Mfg. Co., Inc., 148 Main St., Monroeville, Ind. Telephnoe 8811

Johnson Service Co., 507 E. Michigan St., Milwaukee 1, Wis. BR-6-9200
(See advertisement on page 29)

Johnson-Williams, Inc., 2625 Park Blvd., Palo Alto 13, Calif. DAvenport 3-4131

Jo-Line Tools, Inc., 8442 Otis St., South Gate, Calif. LOrain 7-1489

Jones Div., Howard B., 1026 S. Homan Ave., Chicago 24, Ill. NE-2-2000

Jones Motrola Corp., 432 Fairfield Ave., Stamford, Conn. DAvis 4-7381

Jones Optical Works, 2400 Massachusetts Ave., Cambridge 40, Mass.—TRowbridge 6-3368—3369
(See advertisement on page 160)

Joy Manufacturing Co., Electrical Prods. Div., 1021 Macklind Ave., St. Louis 10, Mo. MIssion 5-6670

Julie Research Laboratories, Inc., 556 W. 168th St., New York 32, N. Y. LO 8-8700

K

K-F Development Co., 2606 Spring St., Redwood City, Calif. EMerson 8-5670

Kahn & Co., Inc., 541 Windsor St., Hartford 1, Conn. CHapel 6-7431

Karn Chemical Equip. Co., 518 Dickson Ave., Pittsburgh 2, Pa. WEllington 1-2983
(See advertisement on page 68)

Karnish Instrument Sales & Service, Inc., 3rd Ave. & Maple, Lock Haven, Pa. LOck Haven 7711

Karr Co., R. J., 1605-16th St., Wyandotte, Mich. AV 4-4100

Kates Co., W. A., 436 Waukegan Road, Deerfield, Ill. WIndsor 5-0950
Rep—W. Pa., W. Va. Md. Panhandle, Ohio Border
Sentinel Products Co. (Wayne B. Farley)
36 Beltzhoover Ave., Pittsburgh 10, Pa.
HEmlock 1-0774

Kato Engineering Co., Mankato, Minn. Telephone 8-2941
(See advertisement on page 101)

Kavamil Co., Inc., 1501 W. El Segundo Blvd., Compton, Calif. NEvada 6-9800

Kay Electric Co., Maple Ave., Pine Brook, N. J. CApital 6-4000

Kearfott Co., Inc., 1500 Main Ave., Clifton, N. J. GEogory 2-1000

Kearfott Microwave Div., Kearfott Co., Inc., 14844 Oxnard St., Van Nuys, Calif. STate 6-1760

Kearney Industries, Delanium Graphite Div., P.O. Box 501, So. Plainfield, N. J. LIberty 9-3800

Keckley Co., O. C., 3400 Cleveland St., Skokie, Ill. ORchard 4-8422

Keim Precision Mirrors Corp., 1346 E. Colorado St., Glendale 5, Calif. CH 5-2725

Keller, Hugo P., 50 E. 42nd St., New York 17, N. Y. MUrray Hill 2-8450
(See advertisement on page 154)

Kelvin Electric Co., 5907 Noble Ave., Van Nuys, Calif. STate 2-6662

Kendrick & Davis Co., 11 Water St., Lebanon 2, New Hamp. LEb. 13

Kensico Tube Co., Inc., Mount Kisco, N. Y. Mount Kisco 6-8046
(See advertisement on page 187)

Kemlite Laboratories, Inc., 1819 W. Grand St., Chicago 22, Ill. TA 9-6050

Kemp Mfg. Co., C. M., 405 E. Oliver St., Baltimore 2, Md. VErnon 7-1190

Kessler Co., Inc., Frank, 41-45 47th St., Long Island City 4, New York STillwell 4-0263
(See advertisement on page 183)

Kieley & Mueller, Inc., 64 Genung St., Middletown, N. Y. DI 2-2526
Pittsburgh Area Representative
W. A. Stoeltzing, Inc.
940 Western Ave., Pittsburgh 33, Pa.
ALlegheny 1-9400

Kings Electronics Co., Inc., 40 Marbledale Rd., Tuckahoe, N. Y. SWiftwater 3-5000

King Engineering Corp., P. O. Box 650, Ann Arbor, Mich. NO. 2-5651
(See advertisement on page 41)

King Tester Corp., 444 N. 13th St., Philadelphia 23, Pa.

Kingston Industries, Inc., North St., Medfield, Mass. FLeetwood 9-4347

Kintronic Div., Chicago Aerial Industries, 10134 Pacific Ave., Franklin Park, Ill. GLadstone 1-1830

Kirkland Co., H. R., 10 King St., Morristown, N. J. JEfferson 8-2777

Kistler Instrument Corp., 15 Webster St., N. Tonawanda, N. Y. Jackson 2099

Klipfel Valves, Inc., 1075 Lincoln Ave., Hamilton, Ohio TWinbrook 5-5661

Knopp Inc., 1307-66th St., Oakland 8, Calif. OLympic 3-1661

Koehler Instrument Co., Inc., 168-56 Dougias Ave., Jamaica 33, N. Y. JAmaica 3-7188

Koontz-Wagner Electric Co., Inc., 516 N. Michigan St., South Bend 1, Ind. CEntral 3-8251

Kollmorgen Optical Corp., 347 King St., Northampton, Mass. JUstice 4-0280

Kruger Instruments, Harold, 313 W. Valley Blvd., San Gabriel, Calif. AT 4-3541

Kulka Electric Corp., 633 So. Fulton Ave., Mt. Vernon, N. Y. MO 4-4024
(See advertisement on page 179)

Kunkle Valve Co., 121 So. Clinton St. Ft. Wayne, Ind. A-7283
(See advertisement on page 52)

Kurman Electric Co., Div. of Norbute Corp., 191 Newel St., Brooklyn 22, N. Y. EVergreen 3-8000

Kurz-Kasch, Inc., 1421 S. Broadway Dayton 1, Ohio. BAldwin 3-8161

Kwikheat Mfg. Co., 3732 San Fernando Rd., Glendale 4, Calif. CHapman 5-2376

L

L.A.B. Corporation, E. Onondaga, Skaneateles, N. Y. OVerbrook 5-5781

L & L Mfg. Co., 136-8th St., Upland, Del. Co., Pa. TRemont 2-5164

L & R Mfg. Co., 577 Elm St., Kearny (Arlington), N. J. Wyman 1-5330

Labline, Inc., 3070-82 W. Grand Ave., Chicago 22, Ill. SAcramento 2-5151

Laboratory Construction Co., 8815 Prospect., Kansas City, Mo. EM-3-1355

Laboratory for Electronics, Inc., 1079 Commonwealth Ave., Boston 15, Mass. ALgonquin 4-4235

Lafayette Instrument Co., By-Pass 52, Lafayette, Ind. SH-2-7937

Lake Erie Electric Mfg., Inc., 2952 W. 22nd St., Erie, Pa.
Pittsburgh and Buffalo Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229

Lamb Electric Co., Div. of Am. Machine & Metals, Inc. Lake St., Kent, Ohio. ORchard 3-3451

Lambda Electronics Corp., 11-11 121st St., College Point 56, N. Y. INdependence 1-8500

Lampkin Laboratories, Inc., IAC Div., Bradenton, Florida Telephone 6-1906

Lancaster Glass Corp., 220 West Main St., Lancaster, Ohio OLive 3-0311

Land-Air, Inc., 7444 W. Wilson Ave., Chicago 31, Ill. Underhill 7-7550

Landis & Gyr, Inc., 45 W. 45th St., New York 36, N. Y. JU-6-4644

Landvork Electrometer Co., 641 Sonora Ave., Glendale 1, Calif. CHapman 56687
(See advertisement on page 124)

Langmar Corp., 4875 W. Armitage Ave., Chicago 39, Ill. BE-7-3375
(See advertisement on page 70)

Lansdale Tube Co., Div. of Philco Corp., Lansdale, Pa.

Lapp Insulator Co., Inc., Process Equip. Div., Lapp St., Leroy, N. Y. Telephone 385

Largent Co., P.O. Box 9845, Houston 15, Texas

Larson Instrument Co., 24 Orchard St., Tarrytown, N. Y. MEdford 1-3419

Lavallee & Ide, Inc., Grape St., Chicopee, Mass. Lyceum 4-6601

LaVezzi Machine Works, 4635 W. Lake St., Chicago 44, Ill. ESterbrook 8-1636

Lavoie Laboratories, Inc., Matawan-Freehold Road, Rte. 79, Morganville, N. J. LOwell 6-2600

Leach Corp., 18435 Susana Road, Compton, Calif. NEvada 6-1061
(See advertisement on page 177)

Leach Relay Div., Leach Corp., 5915 Avalon Blvd., Los Angeles 3, Calif.

Ledeen Inc., 3350 No. Gilman Rd., El Monte, Calif. CUmberland 3-3163

Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa. DAvenport 9-4900

Lee Spring Co., Div. of Leetronics Inc., 30 Main St. Brooklyn 1, N. Y. ULster 5-7163

Leetronics, Inc., 30 Main St., Brooklyn 1, N. Y. ULster 5-7163

Leiman Bros., Inc., 146-181 Christie St., Newark 5, N. J. MA-3-7520

Lel, Inc., 380 Oak St., Copiague, N. Y. AMityville 4-2200

Leland Inc., G. H. 123 Webster St., Dayton 2, Ohio BAldwin 4-9891

Lenox Instrument Co., 2010 Chancellor St., Philadelphia 3, Pa. RIttenhouse 6-6653

Leonard, Inc., Wallace O., 373 So. Fair Oaks Ave., Pasadena, Calif. SYCamore 2-7131 or RYan 1-4446

Lepel High Frequency Laboratories, Inc., 54-18 37th Ave., Woodside 77, N. Y. HAvemeyer 6-4580

Lerco Electronics, Inc., 501 So. Varney St., Burbank, Calif. Victoria 9-5556

Leroy M. E. Clausing Co., 8038 Monticello Ave., Skokie, Ill. Chicago Tel. COrnelia 7-3399

Leslie Co., 122 Delafield Ave., Lyndhurst, N. J. GEneva 8-8000
Pittsburgh Representative
Harold G. Jones Company
602 Empire Bldg., Pittsburgh 22, Pa.
ATlantic 1-8212

Levin & Son, Louis, 3610 S. Broadway, Los Angeles 7, Calif. ADams 3-7169

Levy & Co., Inc., Max, Wayne Ave. & Berkley St., Philadelphia 44, Pa. DA-9-7675
(See advertisement on page 178)

Lewis Engineering Co., 389 Church St., Naugatuck, Conn. PArk 9-5253
(See advertisement on page 21)

Lewis and Kaufman, Ltd., 17320 El Rancho Ave., Los Gatos, California. ELgato 4-3540

Librascope, Inc., 808 Western Ave., Glendale 1, Calif. CItrus 4-6541
Northeastern Rep—Burbank Div.
Davidson and Hemmendinger
2857 Nazareth Rd., Easton, Pa.
BLackburn 8-2345

Lignum-Vitae Products Corp., 96-1P Boyd Ave., Jersey City 4, N. J. HE-3-3027-8
(See advertisement on page 152)

Lind Corp., Research Park, Princeton, N. J. WAlnut 1-8844

Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

Linear Controls Co., 3400 Main, Skokie, Ill. ORchard 6-1667

Link Aviation, Inc., Binghamton, N. Y. RA-3-9311
(See advertisement on page 130)

Liquidometer Corp., Industrial Div., 41-03 36th St., Long Island City 1, N. Y. STillwell 4-1440
(See advertisement on page 42)

Littelfuse, Inc., 1865 Miner St., Des Plaines, Ill. VA 4-1188
(See advertisement on page 166)

Loe Engineering Co., 287 N. Fair Oaks, Pasadena, Calif.
(See advertisement on page 121)

Lord Manufacturing Co., 1635 W. 12th St., Erie, Pa. GLendale 6-8511

Los Angeles Scientific Instrument Co., 2451 Riverside Dr., Los Angeles 39, Calif. NO-2-2128
(See advertisement on page 141)

Lovejoy Flexible Coupling Co., 4843 W. Lake St., Chicago 44, Ill. ES-9-3010

Lucifer Furnaces, Inc., 374 Easton Road, Neshaminy, Pa. Diamond 3-0411

Luther Mfg. Co., 7312 Varna Ave., No. Hollywood, Calif.

Luxo Lamp Corp., Dock St., Port Chester, N. Y. WEstmore 7-4433

Lynn, Robert M., 319 N. Santa Anita Ave., Arcadia, Calif.
(See advertisement on page 210)

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M

MB Electronics, div. of Textron Electronics, Inc., 781 Whalley Ave., New Haven 10, Conn. FUlton 9-1511

M-H (see Minneapolis-Honeywell)

MM Enclosures, Inc., 111 Bloomingdale Road, Hicksville, L. I., N. Y. WEIls 1-1770

M & Q Plastic Products, Bannard St., Freehold, N. J. FRechold 8-6663

MSA Research Corp., Callery, Pa. Evans City 3510

Machinery Electrification, Inc., 35 Hudson St., Northboro, Mass. EXeter 32461

Mack Electric Devices, Inc., 38 Glenside Ave., Wyncote, Pa. TUrner 4-8123
(See advertisement on page 210)

MacLaren & Co., F. B., 6 West 18th St., Huntington Station, New York. HA 3-4433

Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill. UNderhill 7-8000

Magnasync Manufacturing Co., Ltd., 5546 Satsuma Ave., No. Hollywood, Calif. ST 7-5493

Magnavox Co., Research Labs., 2255 S. Carmelina Ave., Los Angeles 64, Calif. BR 2-0347

Magnecraft Electric Co., 3352 W. Grand Ave., Chicago 51, Ill. Everglade 4-6868

Magnetic Instrument Co., Inc., 546 Commerce St., Thornwood, N. Y. RO 9-5312

Magnetic Research Corp., 3160 W. El Segundo Blvd., Hawthorne, Calif. OSborne 5-1171

Magnetic Shield Div., Perfection Mica Co., 1322 N. Elston Ave., Chicago 22, Ill. EVergiade 4-2122
(See advertisement on page 167)

Magnetico, Inc., 6 Richter Court, E. Northport, N. Y. ANdrew 1-4502

Magnetrol, Inc., 2110 So. Marshall Blvd., Chicago 23, Ill. Bishop 7-4000
(See advertisement on page 42)

Main & Sons, Inc. Robt. A., 461 W. Main St., Wyckoff, N. J.

Malco Manufacturing Co., 4025 West Lake St., Chicago 24, Ill. VAn Buren 6-9300

Mallory & Co. Inc., P. R., 36 So. Gray St., Indianapolis 6, Ind. MElrose 6-5353

Manning, Maxwell & Moore, Inc., Stratford, Conn. DRexel 8-8281

Mansfield & Green, Inc., 1051 Power Ave., Cleveland 14, Ohio. MAin 1-7565
(See advertisement on page 54)

Manson Laboratories, Inc., 375 Fairfield Ave., Stamford, Conn. DAvis 5-1391

Marathon Battery Co., 840 Henrietta St., Wausau, Wis. Telephone 2-1071

Marathon Electric Mfg. Corp., Wausau, Wis. Telephone 2-2011

Marconi Instruments, 111 Cedar Lane, Englewood, N. J. LO-7-0607-8-9

Mark-Tex Corp., 453 W. 17th St., New York 33, N. Y. WAtkins 9-1811

Marotta Valve Corp., 1500 Boonton Ave., Boonton, N. J. DEerfield 4-2791

Marquardt Corp., Pomona Div., 2709 N. Garey Ave., Pomona, Calif. LYcoming 3-1311

Marsh Instrument Co., 3501 Howard St., Skokie, Ill. ORchard 3-4300
(See advertisement on page 54)

Marshall Co., L. H., Station B, Columbus 2, Ohio AX 9-4159

Marshall Instruments Inc., 14203 Bessemer St., Van Nuys, Calif. STate 2-4014

Marshalltown Mfg. Co., 800 E. Nevada St., Marshalltown 3, Iowa. Telephone 4461
(See advertisement on page 49)
Pittsburgh Representative
Harold G. Jones Company
602 Empire Bldg., Pittsburgh 22, Pa.
ATlantic 1-8212

Martin & Co., H. S., 1916 Greenleaf St., Evanston, Ill. GR 5-0707
(See advertisement on page 121)

Martindale Electric Co., 1360 Hird Ave., Cleveland 7, Ohio. LAkewood 1-8567

Marx Co., Clarence J., 184 East 199th St., Cleveland 19, Ohio. KEnmore 1-8952
(See advertisement on page 61)

Mason-Neilan Div., Worthington Corp., 55 Nahatan St., Norwood, Mass. NOrwood 7-4600
(See advertisement on page 75)

Massa Div. of Cohu Electronics, Inc., 5 Fottler Rd., Hingham, Mass. RIverview 9-4800

Mast Development Co., Inc., 2212 E. 12th St., Davenport 30, Iowa. Telephone 3-9720

Master Specialties Co., 956 East 108th St., Los Angeles 59, Calif. LOrain 4-4481

Maxson Corp., W. L., 475 Tenth Ave., New York 18, N. Y. LOngacre 5-1900

Mayer Co., Inc., Geo. J., 546 E. Market St., Indianapolis 9, Ind. MElrose 6-6422
(See advertisement on page 169)

McCoy Electronics Co., Chestnut and Watts St., Mount Holly Springs, Penna. HUnter 6-3411

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. . . the only Mercury Relay* with a Teflon plunger bearing surface

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Box 97, Wyncote, Pa. Phone TUrner 4-8123
Teflon-DuPont Trade Name for Tetrafluoroethylene Resin

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McDanel Refractory Porcelain Co., 510 9th Ave., Beaver Falls, Pa. TIlden 3-8300

McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill. COrnelia 7-1600

McHugh & Son, Raymond F., Box 6025, Philadelphia 14, Pa. MA 4-8009

McIlvaine, O. T., 15 So. First St., Geneva, Ill. GEneva 7150

McKenna Laboratories, 2503 Main St., Santa Monica, Calif. EXbrook 9-8846

McLean Engineering Laboratories, 70 Washington Road, P.O. Box 228, Princeton, N. J. WAlnut 4-4440

McMillan Laboratories, Inc., Brownville Ave., Ipswich, Mass.
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Measurements Div., Mc-Graw-Edison Co., Box 180, Boonton, N. J.
(See advertisement on page 103)

Measurements Research Co., 3801 Castor Ave., Philadelphia 24, Pa. JEfferson 5-0911

Mechanical Products, Inc., 1824 River St., Jackson, Mich. STate 2-0391

Meikle Manufacturing Co., 1335 So. MacArthur Blvd., Springfield, Ill. Telephone 2-1680

Mercoid Corp., 4201 Belmont, Chicago 41, Ill. Pensacola 6-2100
(See advertisement on page 180)
St. Louis Representative
Fille Sales & Engineering Co.
4401 Choteau Ave., St. Louis, Mo.
JEfferson 1-0477

Meriam Instrument Co., 10920 Madison Ave., Cleveland 2, O. ATlantic 1-1100
(See advertisement on page 35, 44)

Merz Engineering, Inc., 200 So. Harding St., Indianapolis 7, Ind. MElrose 2-7431

Metalab Equipment Co., Duffy Ave., Hicksville, L. I., N. Y.

Metalphoto Corp., 6811 Superior Ave., Cleveland 3, Ohio UTah 1-7575

Metals & Controls Div., Texas Instruments Inc., 34 Forest St., Attleboro, Mass. Telephone 1-2800

Metavac, Inc., 45-68 162nd St., Flushing 58, New York HIckory 5-0400
(See advertisement on page 171)

Meters Inc., 5353 N. Keystone Ave., Indianapolis 20, Ind. CLifford 5-3570

Metrol, Inc., 17 E. Holly St., Pasadena, Calif. SYcamore 3-3085

Metron Instrument Co., 432 Lincoln St., Denver 3, Colo. PEarl 3-3764

Metronix, Inc., 75 Wilson Mills Road, Chesterland, Ohio HAmilton 3-4440

Metzger & Son, F. F., 2600 N. 6th St., Philadelphia 33, Pa. BA 9-3161

Mice Instrument Co., 80 Trowbridge St., Cambridge 38, Mass. KI 7-8660
(See advertisement on page 168)

Micro Balancing, Inc., 191 Herricks Road, Garden City Park, L. I., N. Y. PI 6-0851

Micro Gee Products, Inc., 6319 W. Slauson Ave., Culver City, Calif. EXmont 1-1716

Micro-Circuits Co., New Buffalo, Mich. Telephone 272-W-1

Microdot, Inc., 220 Pasadena Ave., So. Pasadena, Calif. RYan 1-3351

Microloc Corp., 5743 Marilyn Ave., Culver City, Calif. TExas 05535

Micromat Co., 548 Piermont Ave., Hillsdale, N. J.

Micrometrical Manufacturing Co., 345 So. Main St., Ann Arbor, Mich. NOrmandy 2-5626

Micronics Div., Elgin National Watch Co., 366 Bluff City Blvd., Elgin, Ill. SHerwood 2-5700

Microsonics Inc., Hingham Industrial Ctr., Hingham, Mass. RI-9-9100

Microtran Co., Inc., 145 E. Mineola Ave., Valley Stream, N. Y. LO-1-6050

Microwave Associates, Inc., South Ave., Burlington, Mass. BRowning 2-3000

Microwave Development Laboratories, Inc., 92 Broad St., Babson Park 57, Wellesley, Mass. CEdar 5-6252

Midwestern Instruments, P.O. Box 7186, Tulsa 12, Okla. RIverside 7-1331

Milgo Electronic Corp., 7601 NW 37th Ave., Miami 47, Fla. OX 1-1220

Miller & Associates, David, Box 572, Beverley Hills, Calif. OL 57861

Miller Company, L. C., 5005 E. Slauson, Los Angeles 22, Calif. Ludlow 3-1065

Miller Falls Co., 57 Wells St., Greenfield, Mass. PR 3-5426

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1343 Sprint Street, N. W.
Telephone: Trinity 4-6378

CHICAGO 10, ILLINOIS
144 West Superior Street
Telephone: Michigan 2-3575

NEW ORLEANS, LOUISIANA
3000 Toulouse Street
Telephone: Amherst 5368

DETROIT 3, MICHIGAN
19725 Ralston
Telephone: Townsend 8-5855

KANSAS CITY 8, MISSOURI
2603 Cherry Street
Telephone: Baltimore 1-9787

BUFFALO 9, NEW YORK
1718 Main Street
Telephone: Garfield 4526

NEW YORK, NEW YORK
1100 Globe Avenue
Mountain Side, N. J.
Telephone: Adams 2-3490

PHILADELPHIA 3, PENNA.
1614 Summer Street
Telephone: Locust 4-1216

PITTSBURGH 8, PENNA.
201 North Braddock Avenue
Telephone: Churchill 1-5900

HOUSTON 6, TEXAS
3745 Greenbriar Drive
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MINE SAFETY APPLIANCES COMPANY
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Millivac Instruments Div., Cohu Electronics, Inc., 2315 Second Ave., Carmen, Schenectady, N. Y. Elgin 5-6550

Milman Engineering Co., 1831 Pontius Ave., Los Angeles 25, Calif. GRanite 3-0616

Milton Ross Metals Co., 239 Jacksonville Rd., Hatboro, Pa. CHbourne 2-0550

Milton Roy Company, 1303 Mermaid Lane, Philadelphia 18, Pa. CHestnut Hill 7-8000

Minarik Electric Co., 224 E. Third St., Los Angeles 13, Calif. MAdison 4-3161

Minco Products, Inc., 740 Washington Ave., N., Minneapolis 1, Minn. FEderal 8-6753

Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa. CH 1-5900
(See advertisement on page 211)

Miniature Precision Bearings, Inc., Precision Park, Keene, N. H. EL-2-1888

Minneapolis Electric & Construction Co., 80 S. 12th St., Minneapolis 3, Minn. FE 2-0946

Minneapolis- Honeywell Regulator Co., Aeronautical Div., 2600 Ridgeway Road, Minneapolis 13, Minn. ST 1-8011

Minneapolis-Honeywell Regulator Co., Boston Div., 40 Life St., Boston 35, Mass. AL-4-5200

Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne & Windrim Aves., Philadelphia 44, Pa. DAvenport 9-8300

Minneapolis-Honeywell Regulator Co., Davies Laboratories Div., 10721 Hanna St., Beltsville, Md. WEbster 5-2700

Minneapolis-Honeywell Regulator Co., Heiland Div., 5200 E. Evans Ave., Denver 22, Colo. SKyline 6-3681

Minneapolis-Honeywell Regulator Co., Marion Instrument Div., Grenier Field, Manchester, N. H. WA-5-6971

Minneapolis-Honeywell Regulator Co., Micro Switch Div., 11 W. Spring St., Freeport, Ill. ADams 2-1122

Minneapolis-Honeywell Regulator Co., Missile Equipment Div., Queen & So. Bailey, Pottstown, Pa.

Minneapolis-Honeywell Regulator Co., Rubicon Instruments Div., Ridge Ave. at 35th St., Philadelphia 32, Pa. BAldwin 5-3737

Minneapolis-Honeywell Regulator Co., Valve Div., Fort Washington, Pa. MItchell 6-1780

Minnesota Mining & Mfg. Co., Magnetic Products Div., 900 Bush Ave., St. Paul 6, Minn. PRospect 6-8511

Missouri Research Labs., Inc., 2109 Locust St., St. Louis 3, Mo. CHestnut 1-7875

Mixing Equipment Co., Inc., 135 Mt. Read Blvd., P.O. Box 1370, Rochester 3, N. Y. ID 6-5550

Model Engrg. & Mfg., Inc., 50 Frederick St., Huntington, Ind. Telephone 104

Model Rectifier Corp., 1675 Utica Ave., Brooklyn 34, N. Y. CLoverdale 8-6800

Modern Industries, Inc., 5755 Camille Ave., Culver City, Calif. TExas 02020

Modern Laboratory Equipment Co., Inc., 1809-11 First Ave., New York 28, N. Y. TR 6-4700

Moeller Instrument Co., 132 St. & 89th Ave., Richmond Hill 18, N. Y. Virginia 9-2100
(See advertisement on Inside Back Cover)

Molex Products Co., 9515 Southview Ave., Brookfield, Ill. HUnter 5-5881

Monroe Calculating Machine Co., Components Div., 60 Main St., San Francisco 5, Calif. DO 2-7328

Monroe Calculating Machine Co., Electronics Div., 555 Mitchell St., Orange, N. J. OR 3-6600

Montgomery Mfg. Co., 212 S. Main, Owensville, Ind. SAratoga 4-2506

Moog Servocontrols, Inc., Proner Airport, E. Aurora N. Y. CYpress 2000
Dallas Representative
Allied Components Inc.
2517 Converse St., Dallas 7, Texas
RIverside 2-2830

Moore Associates, Inc., 2600 Spring St., Redwood City, Calif. EMerson 9-0204

Moore & Co., Samuel, Dekoron Products Div., Main & Orchard St., Mantua, Ohio, CRestwood 4-2276
(See advertisement on pages 142, 143)

Moore Products Co. H & Lycoming Sts., Philadelphia 24, Pa. JE 3-3500

Morehouse Machine Co., 1742 Sixth Ave., York, Penna. Telephone 81332
(See advertisement on page 134)

Morris Co., J. I., 384 Elm St., Southbridge, Mass. POrter 4-4394

Moseley Co., F. L., 409 N. Fair Oaks Ave., Pasadena, Calif. RYan 1-0208
(See advertisement on pages 116, 117)

Moser Jewel Co., 544 Fayette St., Perth Amboy, N. J. HIllcrest 2-3434
(See advertisement on page 153)

Metech Co., P.O. Box 6009, Kansas City 10, Mo. LOgan 1-0202
(See advertisement on page 65)

Motorola C&E Inc., 4501 W. Augusta, Chicago 51, Ill. SP 2-6500

Motson Co., J. Frank, 1717 Bethlehem Pike, Flourtown, Pa. CHestnut Hill 7-1900

Mucon Corp., 9 St. Francis St., Newark 5, N. J.

Mueller Co., 512 W. Cerro Gordo St., Decatur, Ill. Telephone 3-4471

Mueller Electric Co., 1583 E. 31st St., Cleveland 14, Ohio

Muirhead Instruments, Inc., 441 Lexington Ave., New York 17, N. Y. MUrray Hill 2-8131

Multi-Amp Corp., 465 C Lehigh Ave., Union, N. J. MUrdock 8-7112

Murphy Mfg. Inc., Frank W. 3137 S. Sheridan, Tulsa 24, Okla. TE 8-3387

Murphy & Miller, Inc., 620 W. Taylor St., Chicago 7, Ill. HArrison 7-8900
(See advertisement on page 34)

N

NJE Corporation, 20 Boright Ave., Kenilworth, N. J. BRidge 2-6000

N/P Company, P.O. Box 127, Temple City, Calif. ATlantic 7-9223

NRC Equipment Corp., 160 Charlemont St., Newton 61, Mass. DE 2-5800

Nanmac Corp., 55 Glymont Road, Indian Head, Md. Riverside 8201
(See advertisement on page 65)

Narda Ultrasonic Corp., 625 Main St., Westbury, L. I. N. Y. EDgewood 3-5400

Nash Engineering Co., So. Norwalk, Conn. VOlunteer 6-3351
(See advertisement on page 18)

National Appliance Co., 7634 S.W. Capitol Hwy., Portland 19, Ore. CHerry 6-3316

National Carbon Co., Div. of Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y. Murray Hill 7-8000

National Electronics Inc., 628 North St., Geneva, Ill. Telephone 7000

National Instrument Co., Inc., 4119-4127 Fordleigh Rd., Baltimore 15, Md. ROgers 4-3304

National Instrument Labs., Inc., 840 Evarts St., N. E., Washington 18, D. C. NOrth 7-7582
(See advertisement on page 36)

National Radiac Inc., 475 Washington St., Newark 2, N. J. MA 3-7524

National Semiconductors Ltd., 146 Bates Road, Montreal 26, P.Q., Canada. RE-7-4031

National Spectrographic Laboratories, Inc., 6300 Euclid Ave., Cleveland 3, Ohio UTah 1-4664

National Time & Signal Corp., 21800 Wyoming Ave., Detroit 37, Mich. JOrdan 46281

National Ultrasonic Corp., 111 Montgomery Ave., Irvington 11, N. J. ESsex 1-0550

National Vulcanized Fibre Co., Maryland Ave. & Beech Sts., Wilmington 99, Del. OLympia 5-6371

Navigation Computer Corp., 1621 Snyder Ave., Philadelphia 45, Pa. HO 5-7700

Naybor Laboratories, Inc., E. V., 26 Manorhaven Blvd., Port Washington, N. Y. POrt Washington 7-4300

Nems-Clarke Co., Div. of Vitro Corp. of Amer., 919 Jesup-Blair Drive, Silver Spring, Md. JUniper 5-1000

Neptune Meter Co., 19 West 50th St., New York 20, N. Y.

Nester Co., Inc., L. G., P.O. Box 231, Buck & Sassafras Sts., Millville, N. J. TAylor 5-0254
(See advertisement on page 188)

Networks Electronic Corp., 14806 Oxnard St., Van Nuys, Calif. STate 2-3114

Neutronic Associates, Inc., 93-14 101st Ave., Ozone Park 16, New York. Virginia 7-7703

New Departure Div., General Motors Corp., 269 N. Main St., Bristol, Conn., Ludlow 2-6371
(See advertisment on page 145)

New England Transformer Co., Inc., 47 McGrath Highway, Somerville 43, Mass. SOmerset 6-6100

New Hampshire Ball Bearings, Inc., Peterborough, N. H. WAlnut 4-3311

New Jersey Meter Co., Inc., 350 Leland Ave., Plainfield, N. J.

New York Transformer Co., Inc., 3rd Ave., Alpha, N. J. GLencourt 4-1143

Newage Industries, Inc., 222 York Rd., Jenkintown 21, Pa. TU 4-8494

Newark Controls Co., 15 Ward St., Bloomfield, N. J. PIlgrim 8-2971

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Newman Corp., M. M., 79 Clifton Ave., Marblehead, Mass. NEptune 2-0637

Non-Linear Systems, Inc., Del Mar Airport, Del Mar, Calif. SKyline 5-1134

Norcross Corp., 247 Newtonville Ave., Newton 58, Mass. DECatur 2-3410
(See advertisement on page 127)

Norman Hardy Associates, Box 97, Wyncote, Penna. TUrner 7-3955

North American Mfg. Co., 4455 E. 71st St., Cleveland 5, O. BRoadway 1-6000

North Atlantic Industries, Inc., 603 Main St., Westbury, N. Y. EDgewood 4-1122

North Electric Co., 553 So. Market St., Galion, O. HO 8-2420

North Hills Electric Co., Inc., 402 Sagamore Ave., Mineola, L. I., N. Y. Pioneer 7-0555
(See advertisement on page 112)

North Shore Nameplate Inc., 214-27 Northern Blvd., Bayside 61, N. Y. BA 4-4000
(See advertisement on page 169)

Northeastern Engrg., Inc., 25 S. Bedford St., Manchester, N. H. NAtional 2-6485

Norwood Controls, 934 Washington St., Norwood, Mass. NOrwood 7-4010
(See advertisement on pages 24, 25)

Nuclear-Chicago Corp., 223 W. Erie St., Chicago 10, Ill. DElaware 7-3060

Nuclear Corp. of America, Instr. & Research Div., 2 Richwood Place, Denville, N. J. WOrth 2-7628

Nuclear Development Laboratory, P. O. Box 7034, Kansas City 13, Mo. DElmar 3-7692

Nuclear Electronics Corp., 2925 N. Broad St., Philadelphia 32, Penna. BAldwin 6-2300

Nuclear Materials and Equipment Corp., Apollo, Pa. GRover 2-8411

Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind. LI 6-2415
(See advertisement on page 124)

Nucleonic Corp. of America, 196 Degraw St., Brooklyn 31, N. Y. MAin 4-7370

Nurnberg Thermometer Co., Scientific Div., 124 Livingston St., Brooklyn 1, N. Y. RE 5-2293

Nylon Molding Corp., 141 South Ave., Garwood, N. J. SUnset 9-1414

O

O.K. Machine & Tool Corp., 551 E. 179th St., New York 57, N. Y. CY-8-0900
(See advertisement on page 122)

OPW-Jordan, Dept. IC, 6013 Wiene Rd., Cincinnati 13, Ohio. WE 1-1263

Oak Manufacturing Co., 1260 Clybourn Ave., Chicago 10, Ill. MO 4-2222

Offner Electronics, Inc., 3900 River Road, Schiller Park, Ill. GLadstone 1-0050

Ohaus Scale Corp., 1050 Commerce Ave., Union, N. J. MUrdock 8-3400

Ohio Carbon Co., 12508 Berea Rd., Cleveland 11, Ohio. CL 2-6100

Ohio Chemical & Surgical Equipment Co., Div. of Air Reduction Co., Inc., 1400 E. Washington Ave., Madison, Wis. ALpine 6-5421

Ohio Semiconductors, Inc., 1035 W. Third Ave., Columbus 8, Ohio. AX 4-4938

Ohmart Corp., 2236 Bogen St., Cincinnati 14, Ohio
Detroit Representative
The Basic Service Corp.
16544 Plymouth Rd., Detroit, Mich.
VErmont 7-8820

Rep—New York, New Jersey Area
George H. Birchall Co., Inc.
P. O. Box 84, Westfield, N. J.
ADams 2-3600

Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis. MItchell 5-6715

Okonite Co., Passaic, N. J. Prescott 7-0400

Oltronix Inc, 235 Underwood Dr., Atlanta 5, Ga. BLackburn 5-2576
(See advertisement on page 101)

Olympic Instruments, Inc., Vashon, Wash. HOward 3-5641
(See advertisement on page 135)

Opad Electric Co., 43-20 Walker St., New York, N. Y. WOrth 6-0380
(See advertisement on page 111)

Optical Coating Lab., Inc., 977 Sebastopol Rd., Santa Rosa, Calif. LIberty 5-6440

Optics Mfg. Corp., Amber & Willard Sts., Philadelphia 34, Pa. GA 5-3222

Optimized Devices, Inc., 864 Franklin Ave., Thornwood, N. Y. ROgers 9-6110

Opto-Metric Tools Inc., 137 Varick St., New York 13, N. Y. ORegon 5-9076
(See advertisement on page 137)

Orbitran Co., Inc., 11487 Woodside Ave., Lakeside, Calif. HIckory 3-6832

Ortho Filter Corp., 7-11 Paterson St., Paterson 2, N. J. MU 4-5858

Oster Mfg. Co., John, Avionic Div., 1 Main St., Racine, Wis. MElrose 74445

Ozone Research & Equip. Corp., 3840 N. 40th Ave., Phoenix, Arizona, AP 8-5452

P

P.B.R. Manufacturing Co., H & Luzene Sts., Philadelphia 24, Pa. GArfield 6-0932
(See advertisement on page 135)

PCA Electronics, Inc., 16799 Schoenborn St., Sepulveda, Calif. EMpire 2-0761
(See advertisement on page 162)

P-W Industries, Inc., 11200 Roosevelt Blvd., Philadelphia 15, Pa.
(See advertisement on page 195)

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Gay Sales Co. Inc., P.O. Box 2904, Istrouma Sta.

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Owen C. Jones Co. P.O. Box 151, Wellesley Hills 82, Mass.

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J. R. Simpson & Co. 1210 S. 17th, Maywood, Ill.

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Abernathy-Thomas Eng. Co., 132 Graymont Drive

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Gay Sales Co. Inc., P. O. B. 8414

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Process Equip. Co. Inc., 2548 W. 29th Ave.

DES MOINES 12, Iowa
Conrad R. Bangh Co. (Geo. W. Swallow), 4006 Grand Ave.

HOUSTON, Texas
Gay Sales Co. Inc., 420 Sul Ross St.

KANSAS CITY 12, Missouri
Power Specialties, 1214 West 47th St.

KINGSPORT, Tenn.
Abernathy-Thomas Eng. Co., 341 W. Market St.

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Calpreco, 1417 Georgia St.

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Conrad R. Bangh, 524 W.O.W. Bldg., 14th & Farnam Sts.

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Penn-Del Inst. Sales Co., 709 Bethlehem Pike

PITTSBURGH 16, Pa.
Biltmore Products Co. Inc., 1501 Potomac Ave.

ROCHESTER 10, N. Y.
Carl A. Pearson Co., 232 Winton Rd., N.

ST. LOUIS 17, Mo.
Fred Zopff Co., 8030 Manchester

SALT LAKE CITY, Utah
Process Equip. Co. 20 E. 2nd South

SAN FRANCISCO 5, Calif.
Oliver B. Lyman Co., 55 New Montgomery St.

SCHENECTADY, New York
Carl A. Pearson Co., 959 Cutler St.

SEATTLE, Wash.
Automation Products, 2800 15th Ave. West

SPOKANE 2, Wash.
Automation Products, North 120 Div. St.

TAMPA 3, Fla.
Minich-DuVon Corp., 2509 W. Hillsboro Ave.

TULSA, Okla.
The Ben McKalip Co., 4176 E. Admiral Pl.

P & H Electronics, Inc., 424 Columbia, Lafayette, Ind. SH 2-0361

PIC Design Corp., 477 Atlantic Ave., East Rockaway, N. Y. LY 9-1143

P. K. Industries, Inc., 27 Porete Ave., North Arlington, N. J.
California Representative
Luscombe Engineering Co.
1129 So. Fair Oaks Ave., Pasadena, Calif. MU-2-3386
130 N. "B" St., San Mateo., Calif. DI-2-7057

P.S.P. Engrg. Co., Div. of Induction Motors Corp., N. Y., 6058 Walker Ave., Maywood, Calif. LUdlow 3-4785

Pace Engineering Co., 13035 Saticoy St., No. Hollywood, Calif. PO 5-0453

Pacific Instrument Co., 4926 East 12th St., Oakland 1, Calif. KE 2-2035

Pacific Semiconductors, Inc., 10451 W. Jefferson Blvd., Culver City, Calif. ORegon 8-4713

Pacific Technical Co., 2407 Sawtelle Blvd., Los Angeles 25, Calif. GRanite 70455

Pacific Transducer Corp., 11836 W. Pico Blvd., Los Angeles 64, Calif. GR 81134

Pacific Universal Products Corp., 168 Vista Ave., Pasadena, Calif. MUrray 1-7646

Packard Bell Electronics Corp., Technical Products Div., 12333 W. Olympic Blvd., Los Angeles 64, Calif.

Pacsol Div. of Illinois Tool Works, 500 E. Franklin Ave., El Segundo, Calif. ORegon 84931

Palmer Thermometers Inc., 2501 Norwood Ave., Cincinnati 12, Ohio. MElrose 1-1500
(See advertisement on page 27)

Palo Laboratory Supplies, Inc., 81 Reede St., New York 7, N. Y. COrtlandt 7-0075

Palos Optical Co., P. O. Box #6, Palos Heights, Ill. GIbson 8-0455

Pancro Mirrors, Inc., 2958 Los Feliz Blvd., Los Angeles 39, Calif. NOrmandy 1-2141

Panduit Corp., 14461 Waverly Ave., Midlothian, Ill. HIlltop 5-3134
(See advertisement on page 190)

Panellit, Inc., 7401 N. Hamlin Ave., Skokie, Ill. ORchard 5-2500

Parabam, Inc., 13000 Yukon Ave., Hawthorne, Calif.
(See advertisement on page 79)

Paragon Electric Co., 1600 - 12th St., Two Rivers, Wis. Telephone 303

Parker Electronics Co., 375 Fairfield Ave., Stamford, Conn. DAvis 3-0954

Parker-Hannifin Corp., Parker Fittings & Hose Div., 17325 Euclid Ave., Cleveland 12, Ohio. KEnmore 1-3000

Par-Metal Products Corp., 32-62 49th St., Long Island City 3, N. Y. AStoria 8-8905

Parr Mfg. Corp., 44 Austin St., Newark 2, N. J. BI 3-2340

Parr Instrument Co., 211 53rd St. Moline, Ill. Telephone 2-7716

Parsons Co., Ralph M., Electronics Div., 151 S. De Lacey Ave., Pasadena, Calif. RYan 1-0461

Partlow Corp., 217 Campion Road, New Hartford, N. Y. Utica SW-7-2222

Pass & Seymour, Inc., 50 Boyd Ave., Syracuse 9, N. Y. HOward 8-6211

Paul, F. H. & Stein Bros., Inc., 235 Fifth Ave., New York 16, N. Y. MUrray Hill 4-6370

Pearson Electronics, Inc., 707 Urban Lane, Palo Alto, Calif. DAvenport 5-3147

Pee-Wee Molding Corp., 1720 Atlantic Ave., Brooklyn 13, N. Y. PR 4-3441

Penberthy Mfg. Co., Div., Buffalo-Eclipse Corp., 1242 Hadden Ave., Detroit 2, Mich.

Penn Instruments Div., Burgess-Manning Co., 4110 Haverford Ave., Philadelphia 4, Pa.
Pittsburgh and Buffalo Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229

Penn Optical & Instrument Co., 19642 Bristol St., Costa Mesa, Calif. KImberly 5-1165
(See advertisement on page 138)

Penn-East Engrg. Corp., Industrial Ave. Kutztown, Pa. OVerbrook 3-7307

Pennsylvania Fluorocarbon Co., Inc., 1115 No. 38th St., Philadelphia 4, Penna. EVergreen 6-0603

Pennsylvania Pump & Compressor Co., Easton, Pa.

Permag Corp., 8-06 Van Wyck Expressway, Jamaica 18, N. Y.
(See advertisement on page 168)

Performance Measurements Co., 15301 W. McNichols Rd., Detroit 35, Mich. VErmont 8-7879

Perkin-Elmer Corp., P. O. Box 730, Norwalk, Conn.

Perkin-Elmer Corp., Vernistat Div., Main Ave., Norwalk, Conn.
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Allied Components Inc.
2517 Converse St., Dallas 7, Texas
RIverside 2-2830

Perkin Engrg. Corp., 345 Kansa St., El Segundo, Calif. ORegon 8-7215

Permanent Magnet Co., 4437 Bragdon St., Indianapolis 26, Ind. LIberty 7-1336

Peschel Electronics, Towners, Patterson RD. 1, N. Y. TRinity 8-3251
(See advertisement on page 105)

Peterson Co., Inc., Stuart D., 65 Culver Parkway, Rochester 9, N. Y. BU 8-2947

Petrometer Corp., 43-22 10th St., Long Island City 1, N. Y. STillwell 4-8042

Pfaltz & Bauer, Inc., 350 5th Ave., New York 1, N. Y. CHickering 4-6485

Phalo Plastics Corp., 530 Boston Turnpike, Shrewsbury, Mass. VIking 4-4021

Philadelphia Scientific Glass Co., Paletown Rd., Quakertown, Penna.
(See advertisement on page 213)

Philamon Laboratories, Inc., 90 Hopper St., Westbury, L. I., N. Y. EDgewood 3-1700

Philbrick Researches, Inc., George A., 285 Columbus Ave., Boston 16, Mass. COmmonwealth 6-5375
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Philco Corp., Govt. & Indus. Div., 4700 Wissahickon Ave., Philadelphia 44, Pa. Victor 3-4000

Phillips & Co., H. A., 3255 W. Carroll Ave., Chicago 24, Ill. NEvada 8-1116

Phillips-Drucker, Inc., P. O. Box 507, Astoria, Oregon FAirfax 5-3241

Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va. MI 3-9163

Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia 40, Pa. BA 8-7417

Photobell Co., Inc., 43 Vesey St., New York 7, N. Y. WOrth 2-6739

Photocon Research Products, 421 N. Altadena Dr., Pasadena, Calif. SYcamore 2-4131

Photomation, Inc., 96 S. Washington Ave., Bergenfield, N. J. DUmont 4-3411

Photoplating Co., 215 N. E. 5th St., Minneapolis 13, Minn. FE 5-1229

Physics Research Laboratories, Inc., P. O. Box 555, Hempstead, N. Y. IVanhoe 3-8299
(See advertisement on pages 94, 114)

Picker X-Ray Corp., Nuclear Instrument Div., 25 S. Broadway, White Plains, N. Y. WHite Plains 8-0080

Piezo Crystal Co., 265 E. Pomfret St., Carlisle, Pa. Telephone 1495

Pimex, Inc., 18 E. 60th St., New York 22, N. Y.

Pittsburgh Lectrodryer, Div. McGraw-Edison Co., 358 32nd St., Pittsburgh 1, Pa. GRant 1-8782

Planet Instrument, Inc., 616 S. Lafayette St., Fort Wayne, Ind. Telephone E-1495

Pneu Hydro Valve Corp., 52 Horse Hill Rd., Cedar Knolls, N. J.

Pneumercator, Co., Inc., 305 E. 46th St., New York 17, N. Y. PL 5-6033

Pollak Corp., Joseph, 85 Freeport St., Boston 22, Mass. AVenue 2-9550
(See advertisement on page 179)

Polymer Corp., 2120 Fairmont Ave., Reading, Pa. FR 6-5791

Polyphase Instrument Co., E. 4th St., Bridgeport, Pa.

Poly-Scientific Corp., 158 College Ave., Blacksburg, Va. PRescott 2-8212

Poole Instruments, Inc., 150 Express St., Box 1532, Dallas 21, Texas. RIverside 7-2353

Porta-Trace, Inc., 50 Wall St., Binghamton, N. Y. RA 3-7510

Porter, Inc., Geo. K., Bethlehem Pike, Hatfield, Pa. VAndyke 2-0513

Post Electronics, Div. of Post Machinery Co., 140 Elliott Street, Beverly, Mass. WA 2-0811

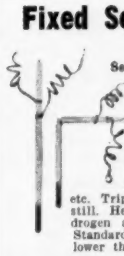
Potter & Brumfield, Inc., 1200 E. Broadway, Princeton, Ind.

Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, N. Y. OVerbrook 1-3200

Power Designs, Inc., 89-25 120th St., Richmond Hill 18, N. Y.
(See advertisement on page 88)
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Powers Regulator Co., 3400 Oakton St., Skokie 10, Ill. ORchard 3-6700

Fixed Set Thermostats



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CIRCLE 394 ON READER-SERVICE CARD

Pratt & Whitney Co., Charter Oak Blvd., West Hartford 1, Conn. ADams 3-7381

Precise Measurements Company, Millbrook St., R. D. 1, Flemington, N. J.—FLemington 900
(See advertisement on page 90)

Precision, Inc., 4748 France Ave., No., Minneapolis, Minn. JU 8-9441

Precision Glass Products Co., 6137 Beechwood St., Philadelphia 38, Pa. GErmantown 8-8005

Precision Line Inc., 63 Main St., Maynard, Mass. TWin Oaks 7-3451

Precision Mechanisms Corp., 577 Newbridge Ave., East Meadow, L. I., N. Y. IVanhoe 3-8955

Precision Paper Tube Co., 2035 W. Charleston St., Chicago 47, Ill. AR 6-5200

Precision Products, Inc., Dept. BG-2, 530 S. Quaker Tulsa 5, Okla. Diamond 5-3116
(See advertisement on page 158)

Precision Products Co., Inc., of Waltham, 26 Bedford St., Waltham 54, Mass. TW 4-1400
(See advertisement on page 193)

Precision Recording Chart Co., 2430 E. Linden Ave., Linden, N. Y. HUnter 6-2102

Precision Resistor Co., 109 U. S. Hwy. #22, Hillside N. J. Bigelow 3-3899

Precision Thermometer & Instr. Co., 1434 Brandywine St., Philadelphia 30, Pa.
Pittsburgh & Buffalo Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3220

Precision Tube Co., Inc., Church Road & Wissahickon Ave., North Wales, Pa. OXbow 9-4806

Preis Engraving Machine Co., H. P. 651 U. S. Highway 22, Hillside 5, N. J. MU-6-7726

Premier Metal Products, Inc., 337 Manida St., Bronx 59, N. Y. WY-1-6600
(See advertisement on page 188)

Presin Co., 2014 Broadway, Santa Monica, Calif. EXbrook 2-9728

Pritchard, J. F. & Co. of Calif., 4625 Roanoke Pkwy., Kansas City 12, Mo. JE 1-9500

Process & Instruments, 15 Stone Ave., Brooklyn 33, N. Y. GLenmore 2-8380

Protective Closures Co., Inc., Caplugs Div., 2207 Elmwood Ave., Buffalo 23, N. Y. BEdford 9855

Pulse Engineering, Inc., 560 Robert Ave., Santa Clara, Calif. CHerry 8-6040

Pyramid Plastics, Inc., 862 W. Polk St., Chicago 7, Ill. WAbash 2-5540
(See advertisement on page 184)

Pyro-Electric, Inc., P. O. Box 152, Winnetka, Ill. Hillcrest 2-6200

Pyrometer Instrument Co., Inc., 92 Portland Ave., Bergenfield 12, N. J. DUmont 4-5140
(See advertisement on page 55)

Pyro Service Co., 17121 Greeley, Detroit 3, Mich. TWinbrook 1-4023

Q

Q.V.S. Inc., 39 N. 15th St., E. Orange, N. J. OHange 3-3994

R

R-B-M Controls Div., Essex Wire Corp., 131 Godfrey St., Logansport, Ind. Telephone 5121

RKL Valve & Mfg. Co., Rt. 23 & Rudderow Ave. Maple Shade, N. J. NOrmandy 3-9150

California Representative
Carkeek Engineering Co.
285 S. Euclid Ave., Pasadena, Calif.
MUrray 1-0489

Racine & Co., Inc., Jules, 20 West 47th St., N. Y. 36, N. Y.
(See advertisement on page 67)

Radex Corp., 3676 Elston Ave., Chicago 14, Ill. ABmitage 6-6900

Radiaphone Co., Inc., 600 E. Evergreen Ave., Monrovia, Cal. ELliott 8-2585

Radiation Applications, Inc., 370 Lexington Ave., New York 17, N. Y. OR 9-9170

Radiation Counter Labs., Inc., 5121 W. Grove St., Skokie, Ill. ORchard 3-8700
Rep—N. Y., N. J., E. Pa., Dela., S. Conn.
M. J. Seavy & Sons
30 Church Street, New York, N. Y.
COrtland 7-8025

Radiation Electronics Corp., 8241 N. Kimball Ave., Skokie, Ill. ORchard 4-4900

Radiation Instrument Development Lab., Inc., 5737 So. Halsted St., Chicago 21, Ill. TRiangle 3-2345

Radio Frequency Labs., Inc., Powerville Rd., Boonton, N. J. DEerfield 4-3100
California Representative
Luscombe Engineering Co.
1129 So. Fair Oakes Ave., Pasadena, Calif. MU-2-5358
130 N. "B" St., San Mateo, Calif. DI-2-7057

Rahm Instruments Div., American Machine, 65 Rushmore St., Westbury, N. Y. EDgewood 3-4840

Railway Communications, Inc., 9351 E. 59th St., Raytown 33, Mo. FLeming 3-2100

Ram Meter Inc., 1100 Hilton Rd., Ferndale 20, Mich. LIncoln 7-1000

Ramo-Wooldridge, Div. of Thompson Ramo Wooldridge Inc., 5500 W. El Segundo Blvd., Los Angeles 45, Calif. ORegon 8-0511

Ramsey Engineering Co., 1853 W. County Road C, St. Paul 13, Minn. MElrose 3-5150

Ranarex Div., Pfaudler Permutit Inc., 50 W. 44th St., New York 36, N. Y.

Ransom Research, 333 W. 7th St., San Pedro, Calif. TErminal 2-6348

Rantec Corp., 23999 Ventura Blvd., Calabasas, Calif. DIamond 75446

Rapid Electric Co., 2831 Middletown Rd., Bronx 61, N. Y. TA-8-2200

Rapid Specialties Co., 325 W. Huron St., Chicago 10, Ill. DElaware 7-1440
(See advertisement on page 158)

Rattray & Co., Geo., 116-08 Myrtle Ave., Richmond Hill 18, New York. VIrginia 6-3250

Raydyne Corp., 2715 So. 4th St., Springfield, Ill. Telephone 2-9122

Raytheon Mfg. Co., Industrial Apparatus Div., Dept. 6120, Waltham 54, Mass.
(See advertisement on page 165)

Rawson Electrical Instrument Co., 112 Potter St., Cambridge, Mass.
(See advertisement on page 106)

Red Jacket Co., Inc., 500 Bell Ave., Carnegie, Pa. WA 1-1202
Pittsburgh Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa.
WAlnut 1-6140

Red Point Corp., 1907 Riverside Drive, Glendale 1, Calif. TH 2-4895

Redford Corp., Instrument Div., Lake Luzerne, N. Y. Telephone 3064

Reeve Electronics, Inc., 609 W. Lake St., Chicago 6, Ill. RAndolph 6-9755

Reeves-Hoffman Div., Dynamics Corp. of Am., 145 Cherry St., Carlisle, Pa. Telephone 2480

Reeves Instrument Corp., Roosevelt Field, Garden City, N. Y. PIoneer 6-8100

Reeves Pulley Co., Div. of Reliance Electric & Engrg. Co., 1225 7th St., Columbus, Ind. DR 6-3311

Reeves Soundcraft Corp., 15 Great Pasture Rd., Danbury, Conn. PIoneer 3-7691

Reflectone Corp., Post Road, Stamford, Conn. DAvis 5-2251

Regent Controls, Inc., Harvard Ave., Stamford, Conn. FIreside 8-7734

Reisner Mfg. Co., W. H., Inc., 240 N. Prospect St., Hagerstown, Md. RE 3-3650

Relay Sales Inc., Dept. AC-25, P. O. Box 186, West Chicago, Ill. W. Chicago 1100

Relay Service Co., 1310 No. Pulaski Rd., Chicago 51, Ill. ALbany 2-2700

Reliance Instrument Mfg. Co. (RIMCOR), 100 Glen Cove Ave., Glen Cove, N. Y. ORiole 6-1040

Renbrandt, Inc., 6 Parmelee St., Boston 18, Mass. HI-5-8010

Renick Co., L. C., 30 S. Salsipuedes St., Santa Barbara, Calif. WO-2-0947
(See advertisement on page 177)

Reon Resistor Corp., 117 Stanley Ave., Yonkers, N. Y. YOnkers 5-9650

Republic Lens Co., Inc., 31 E. 169th St., New York 52, N. Y. CYpress 3-2790

Republic Mfg. Co., 15655 Brookpark Rd., Cleveland 35, Ohio. CLearwater 2-1800

Rese Engineering, Inc., 731 Arch St., Philadelphia 6, Pa. WAlnut 2-5841

Research Inc., 115 No. Bushanan Ave., Hopkins, Minn. WE 5-2156
(See advertisement on page 53)

Research Appliance Co., Rt. 8 at Craighead Rd., Box 307 Allison Park, Pa. STerling 2-2262
(See advertisement on page 67)

Research Controls, Box 5035, Tulsa, Okla. TEmple 8-9434
Rep—W. Pa., W. Va., Md. Panhandle, Ohio Border
Sentinel Products Co. (Wayne B. Farley)
36 Beltzhoover Ave., Pittsburgh 10, Pa.
HEmlock 1-0774

Research Products Co., 1415 - 3rd St., So., St. Petersburg, Fla. Telephone 7-8462

Research Specialties Co., 200 S. Garrard Blvd., Richmond, Calif. BEacon 5-9110

Resistors, Inc., 5226 W. 26th St., Chicago 50, Ill. OL 2-7555

Revere Corp. of America (Subsidiary of Neptune Meter Co.), North Colony Road, Wallingford, Conn.
(See advertisement on page 136)

Rex Rheostat Co., 149 Babylon Turnpike, Roosevelt, L. I., N. Y. FResport 9-1030
(See advertisement on page 191)

Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford 6, Conn. JAckson 2-4265

Richards Co., Arklay S., Inc., 52 Winchester St., Newton Highlands 61, Mass. LAsell 7-4385

Richardson Co., 27th Ave. and Lake St., Melrose Park, Ill.

Richardson Camera Co., Inc., 2526 N. Ontario St., Burbank, Calif. VIctoria 94637

Richardson Scale Co., Clifton, N. J.

Riehle Testing Machines Div., American Machine & Metals, Inc., East Moline, Ill. Telephone 3-4561

Riggs Nucleonics Corp., 717 N. Victory Blvd., Burbank, Calif. VIctoria 9-2481

Rinco, Inc., 7962 S. E. Powell, Portland 6, Oregon PR 4-3259

Riverbank Laboratories, Dept. of Engrg., 1512 So. Batavia Ave., P. O. Box 65, Geneva, Ill. Telephone 2207

Rixon Electronics, Inc., 2414 Reedie Dr., Silver Spring, Md. LO 5-4578

Robinson Technical Products, Inc., (formerly Robinson Aviation, Inc.), Teterboro Air Terminal, Teterboro, N. J. ATlas 8-2500

Robbins & Myers, Inc., 1345 Lagonda Ave., Springfield, Ohio. FAirfax 3-6461

Robbins Aviation Inc., 2350 E. 38th St., Los Angeles 58, Calif. LUdlow 9-5221

Robins Industries Corp., 36-27 Prince St., Flushing 54, N. Y. HI 5-7200

Robinson Orifice Fitting Co., 2830 Lugo St., Los Angeles 23, Calif. ANgelus 9-1161

Rochester Div., Consolidated Electrodynamics Corp. (See Consolidated Vacuum)

Rockbestos Products Corp., Nicoll & Canner Sts., New Haven 4, Conn.

Rockland Insulated Wire & Cable Co., Inc., 36 Main St., Haverstraw, N. Y. HAverstraw 9-3103

Rockwell Engineering Co., 2141 E. 45th St., Indianapolis 5, Ind. CLifford 1-9453

Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa. CHurchill 1-8400

Rockwell Co., W. S., 2128 Eliot St., Fairfield, Conn.
Pittsburgh Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa.
WAlnut 1-6140

Rodale Mfg. Co., Inc., 6th Minor St., Emmaus, Pa. WOodring 59071

Rogan Brothers, 9031 N. Monticello, Skokie, Ill. ORchard 5-1233
(See advertisement on page 166)

Rohde & Schwarz, 111 Lexington Ave., Box 275, Passaic, N. J.
New England Representative
Instrument Dynamics, Inc.
11 Albion St., Wakefield, Mass. CRystal 6-5100
Branch: 75 Wilcox Rd., Milford, Conn.

Rome Cable Corp., 421 Ridge St., Rome, N. Y. ROme 3000

Ronningen Quick Coupling Filters, 6700 Ronningen Rd., Vicksburg, Mich.
Pittsburgh Area Representative
Forbes-Western, Inc.
940 Western Ave., Pittsburgh 33, Pa.
ALlegheny 1-9400

Rotary Devices Corp., 40 Jay St., Englewood, N. J. LOwell 9-0433

Rotating Components Inc., 267 Green St., Brooklyn 22, N. Y. EVergreen 9-3490

Rowe Engravers, Inc., 262 E. 16th St., Paterson 4, N. J. MUlberry 4-1426

Royal McBee Corp., Data Processing Div., Westchester Ave., Port Chester, N. Y. WEstmore 7-3000

Royco Instruments Inc., 874 Fabian Way, Palo Alto, Calif. DAvenport 5-2277

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ROYSON ENGINEERING

HATBORO, PA. OSborne 5-2800

CIRCLE 395 ON READER-SERVICE CARD

Royson Engineering Co., 103 N. Penn St., Hatboro, Pa. OS 5-2800
(See advertisement on page 215)

Rueckert Mfg. Co., 83 King St., East Greenwich, R. I. TUrner 4-2200

Ruge Associates, Arthur C., Inc., Hudson, N. H. TUxedo 2-5195
(See advertisement on page 65)

Rep—E. Pa., S. N. J., Dela., Md., D. C., Va.
Polymetric Devices Co., Inc.
P. O. Box 236, Glenside, Pa. TU-7-4873
P. O. Box 246, Silver Spring, Md.

Ruska Instrument Corp., 6121 Hillcroft, Houston 36, Texas. GYpsy 4-2533
Rep—N. Y., N. J., E. Pa., Dela., S. Conn.
M. J. Seavy & Sons
30 Church St., New York, N. Y.
COrtland 7-8025

Rust Industrial Co., Inc., 130 Silver St., Manchester, N. H. NAtional 3-3596

Rutherford Electronics Co., 8944 Lindblade St., Culver City, Calif. VErmont 9-0116

Ryan Recording Thermometer Co., 851 Poplar Pl., Seattle 44, Wash. EAst 2-8600

S

Sage Electronics Corp., Country Club Road, East Rochester, N. Y. LU 6-8010

Sanborn Co., 175 Wyman St., Waltham 54, Mass. TWinbrook 4-6300
(See advertisement on pages 84, 85)

Sanders Laboratories, 83 Uhland St., E. Rutherford, N. J. WEbster 9-2600

Sandy Manufacturing Co., 26 Maple Ave., Sellersville, Pa. ALpine 7-2989

San Fernando Electric Mfg. Co., 1509 First St., San Fernando, Calif. EMpire 1-8681

Sangamo Electric Co., Springfield, Ill. Telephone 4-6411

Saxonburg Ceramics, Inc., Saxonburg, Penna.

Scala Radio Co., 2314 19th St., San Francisco 10, Calif. VAlencia 6-2898

Scam Instrument Corp., 1811 W. Irving Park Road, Chicago 13, Ill. GR 7-7850
Pittsburgh and Buffalo Representative
M. S. Jacobs & Associates, Inc.
810 Noblestown Rd., Pittsburgh 5, Pa. WA-1-6140
1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229

Scanivale Sales Co., Box 9814, Arlington 9, Va. JAckson 5-4541

Schaevitz Engineering, U. S. Route 130 & Schaevitz Blvd., Pennsauken, N. J. NOrmandy 2-8000

Schauer Manufacturing Corp., 4500 Alpine Ave., Cincinnati 42, Ohio. SYcamore 1-3030

Scherr Co., George, Inc., 200 Lafayette St., New York 12, N. Y. CAnal 6-3512

Schueler & Company, 75 Cliff St., New York 38, N. Y. BE 3-2813

Schutte and Koerting Co., State Road, Cornwells Heights, Bucks County, Pa. MEroury 9-0900

Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J. PIlgrim 3-2200

Scientific Industries, Inc., 15 Park Street, Springfield 3, Mass. REpublic 2-6233

Scientific Instrument Co., 1041 Second Ave., Detroit 26, Mich. WOodward 2-9060

Scientific Products Co., 4200 Deepwater Terminal Road, Richmond 24, Va. BElmont 38356

Schneider Mfg. Company, 2 Linden St., Reading, Mass. RE 2-0440

Sciaky Bros., Inc., 4915 W. 67th St., Chicago 38, Ill. PArtsmouth 7-3600

Scopes Company, Inc., P. O. Box 56, Monsey, N. Y. ELmwood 6-6339

Scott, Inc., H. H., Instrument Div., 111 Powder Mill Road, Maynard, Mass. TW 7-3801

Scott Testers, Inc., 101 Blackstone St., Providence 1, R. I. DExter 1-2853

Scrayco Mfg. Co., 201 Greene Ave., Middlesex, N. J. EL 6-2955

Seco Manufacturing Co., 5015 Penn Ave., S., Minneapolis 19, Minn. WAlnut 6-4545

Seegers Manufacturing, 515 Main St., Barrington, Ill. DU 1-2314
(See advertisement on page 48)

Seely Instrument Co., Inc., 377 Fourth St., Niagara Falls, N. Y. BUtler 2-1276

Seico Instrument Div., Eclipse Fuel Engrg. Co., Rockford, Ill. WOodland 8-3751

Selas Corp. of America, Dresher, Pa. MItchell 6-6600

Sel-Rex Corp., 75 River Road, Nutley 10, N. J. NU 2-5200

Semi-Elements, Inc., Saxonburg Blvd., Saxonburg, Pa. FLanders 2-2548
(See advertisement on page 160)

Semon Bache & Co. (see Bache)

Sensitive Research Instrument Corp., 310 Main St., New Rochelle, N. Y. BEverly 5-2300
(See advertisement on pages 97, 98, 99, 100)

Sequoia Wire & Cable Co., 2201 Bay Road, Redwood City, Calif. EMerson 9-0331

Service Recorder Co., 1013½ Rockwell Ave., Cleveland 14, Ohio.
Representative
John T. Fuhrman, Jr.
6822 Thomas Blvd., Pittsburgh 8, Pa.
MOntrose 1-3838

Servo Systems Co., 14 Carmer Ave., Belleville 9, N. J. PLymouth 9-2875

Servo-Dynamics Corp., Main St., Somersworth, N. H. SOmersworth 1126

Servomster Corporation, 222 Main Ave., Passaic, New Jersey
(See advertisement on page 155)

Servonic Instruments, Inc., 640 Terminal Way, Costa Mesa, Calif. Midway 6-2427
(See advertisement on page 50)

Servonics, Inc., 822 N. Henry St., Alexandria, Va. TE 6-6800

Seton Name Plate Co., 431 West Rock Ave., New Haven 15, Conn. FUlton 9-9581

Shallcross Mfg. Co., Preston St., Selma, N. C. WOodlawn 5-2341

Shaw Instrument Corp., P. O. Box A-46 Latrobe, Penna.
(See advertisement on page 56)

Sheffield Corp., Box 893, Dayton 1, Ohio. CLearwater 4-5377

Shockley Transistor Corp., Sub. of Beckman Instruments, Inc., 1117 California Ave., Palo Alto, Calif. DAvenport 1-2121

Shore Instrument & Mfg. Co., Inc., 9035 Van Wyck Expressway, Jamaica 35, N. Y. Jamaica 6-4090
(See advertisement on page 136)

Sierra Electronic Corp., 3885 Bohannon Drive, Menlo Park, Calif. DAvenport 6-2060

Sierra Engineering Co., 123 E. Montecito Ave., Sierra Madre, Calif. RYan 1-9391

Sigma Instruments, Inc., 170 Pearl St., So. Braintree 85, Mass. VIctor 3-5000

Sigmamotor Inc., 3 N. Main St., Middleport, N. Y. RE 5-3611

Silicon Transistor Corp., 150 Glen Cove Road, Carle Place, Long Island, N. Y. PIoneer 2-4100

Simmonds Aerocessories, Inc., 105 White Plains Rd., Tarrytown, N. Y. MEdford 1-7500

Simplex Valve & Meter Co., 7 East Orange St., Lancaster, Pa. EXpress 4-3792

Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Simpson Optical Mfg. Co., 3200 W. Carroll Ave., Chicago 24, Ill. Van Buren 6-3030
(See advertisement on page 170)

SALES OFFICES

CALIFORNIA
Simpson Optical Manufacturing Company
1127 Wilshire Boulevard
Los Angeles 17, California
HUntley 2-4672

MASSACHUSETTS
Simpson Optical Manufacturing Company
Concord Road
South Lincoln, Massachusetts
CLearwater 9-9532

TEXAS
Simpson Optical Manufacturing Company
c/o Southern Industrial Electronics, Inc.
429 Exchange Bank, Dallas, Texas
FLeetwood 2-8995

Size Control Co., Div. of American Gage & Machine Co., 2500 W. Washington Blvd., Chicago 12, Ill. MOnroe 6-6710

Skinner Electric Valve Div., 95 Edgewood Ave., New Britain, Conn. BAldwin 5-6421
(See advertisement on page 16)

Slaughter Co., Inc., 521 Young St., Piqua, Ohio. PR 3-5936

Slip Ring Company of America, 5456 W. Washington Blvd., Los Angeles 16, Calif. WEbster 1-8156

Slocomb Co., J. T., 68 Matson Hill Rd., So. Glastonbury, Conn. MEdford 3-9485

Smith, Inc., Arthur F., 311 Alexander St., Rochester 4, N. Y. BAker 5-4670

Smith Corp., A. O., 3533 N. 27th St., Milwaukee 1, Wis. UP 3-3000

Smith Mfg. Co., Inc., E. C., Forrest & Hector Sts., Conshohocken, Pa. TAylor 8-4790

Smith Welding Equipment Corp., 2633 4th St., S.E., Minneapolis 14, Minn. FEderal 1-1311

Snap-Tite, Inc., 201 Titusville Rd., Union City, Pa.

Sola Electric Co., 4633 West 16th St., Chicago 50, Ill. BI 2-1414

Solid State Electronics Co., 8153 Orion, Van Nuys, Calif. STate 2-5059

Sonoflux Div., Peterson Machine Tool, Inc., 6200 Merriam Drive, Merriam, Kansas. HEdrick 2-7500

Sorensen & Co., Inc., Richards Ave., South Norwalk, Conn. TE-8-6571

Sorvall, Inc., Ivan, Pearl St., Norwalk, Conn. VI 7-2491

Southwestern Industrial Electronics, 10201 Westheimer Road, Houston 19, Texas. HO 5-3471

Space Products, 2235 E. Artesia Blvd., Long Beach 5, Calif. MEtcalf 06622

Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y. JAckson 2000

Special Instruments Laboratory Inc., 312 W. Vine Ave., Knoxville, Tenn. Telephone 50216

Special Screw Products Co., 100 Northfield Rd., Bedford, Ohio. BEdford 2-6565
(See advertisement on page 166)

Specialties, Inc., Skunks Misery Rd., Syosset, L. I., N. Y. WAlnut 1-2345

Spectra Electronics Corp., 250 E. Third St., Mount Vernon, N. Y. MOunt Vernon 8-1378

Spectrol Electronics Corp., 1704 So. Del Mar Ave., San Gabriel, Calif. ATlantic 7-9761

Spectrum Instruments, Inc., Box 61, Steinway Station, Long Island City 3, N. Y. AStoria 8-8033

Spellman High Voltage Co., 3029 Webster Ave., Bronx 67, N. Y. Kingsbridge 7-0300
(See advertisement on page 110)

Spencer-Kennedy Laboratories, Inc., 1320 Soldiers Field Rd., Boston 35, Mass.

Sperry Products, Inc., Shelter Rock Road, Danbury, Conn. Pioneer 8-3581

Sprague Engineering Corp., 19300 So. Vermount Ave., Gardena, Calif.
(See advertisement on page 52)

Sprengnether Inst. Co., 4567 Swan Ave., St. Louis 10, Missouri
(See advertisement on page 131)

Spring Specialty Co., 23 North 5th Ave., Maywood, Ill. FIlmore 4-4602
(See advertisement on page 215)

LEIGH Pocket Tools

No. 787 Carbide end Steel Scriber $2.50

Points reverse for personal safety. Approximately ½"x3/64" dia., solid carbide rod brazed into steel *(not just tipped)* permits many regrindings.

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23 N. Fifth Ave. • Maywood, Ill.

CIRCLE 396 ON READER-SERVICE CARD

Stackpole Carbon Co., St. Marys, Pa. TErminal 41-521

Standard Cabinet Company, 53 Washington Ave., Carlstadt, N. Y.
(See advertisement on page 34)

Standard Controls, Inc., 1130 Poplar Place, Seattle 44, Wash. EAst 4-8888 and 3-8545

Standard Gage Co., Inc., Poughkeepsie, N. Y. GR 1-3100

Standard Electric Time Co., 89 Logan St., Springfield 2, Mass. REpublic 6-7237

Standard Electrical Products Co., 2240 East 3rd St., Dayton 3, Ohio. CLearwater 3-1191

Standard Electronics Co., 1611 W. 63rd St., Chicago 36, Ill. PR 8-4222
(See advertisement on page 160)

Standard Instrument Corp., 657 Broadway, New York 12, N. Y. ORegon 3-3200

Standard Pressed Steel Co., Jenkintown, Pa. TUrner 4-7300

Standard Screw Co., 2520 Washington Blvd., Bellwood, Ill. ES 8-7400

Stanpat Co., 150-42 12th Rd., Whitestone 57, N. Y. FLushing 9-1693
(See advertisement on page 195)

Staplex Co., Air Sampler Div., 777 Fifth Ave., Brooklyn 32, N. Y. SOuth 8-2335

Starrett Co., L. S., 1-165 Crescent St., Athol, Mass. CHurchill 9-3551

States Company, 19 New Park Ave., Hartford 6, Conn.
(See advertisement on page 108)

Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif. BRadshaw 20371

Stavid Engineering, Inc., U. S. Highway 22, Plainfield, N. J. PL 7-1600

Steina, Inc., 200 Henry St., Stamford, Conn. DAvis 4-7561

Sterling Precision Corp., Instrument Div., 17 Matinecock Ave., Port Washington, N. Y. PO 7-7200

Sterling Transformer Corp., 297 No. 7th St., Brooklyn 11, N. Y. STagg 2-4200

Stevens Mfg. Co., Inc., P. O. Box 1007, Mansfield, Ohio. TUxedo 4-1311

Stevens Mfg. Co., George, Inc., 6022 N. Rogers Ave., Chicago 46, Ill. JU 8-1300

Stevens-Arnold Inc., 7 Elkins St., So. Boston 27, Mass. ANdrew 8-1170
(See advertisement on page 176)

Stewart, M. C., Ashburnham, Mass. TAlbot 7-5840

Stewart Corp., F. W., 4311-13 No. Ravenswood Ave., Chicago 13, Ill. GRaceland 2-6600
(See advertisement on page 192)

Sticht Co., Herman, Inc., 27 Park Place, New York 7, N. Y. REctor 2-8163
(See advertisement on pages 61, 103, 104)

Stocker & Yale, Inc., 40 Green St., Marblehead, Mass. NEptune 1-0038

Strasbaugh, R. Howard, 10990 Santa Fe Ave., Lynwood, Calif. NEvada 6-1128

Stratos Div. of Fairchild Engine & Airplane Corp., Orinoco Dr., Bay Shore, N. Y.

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1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229

Streeter Amet Co., Slusser & Wicks, Grayslake, Ill. BAldwin 3-4801

Stretch Wire Corp., P. O. Box 893, New Rochelle, N. Y. NE 6-6900

Stromberg-Carlson Co., Div. of General Dynamics Corp., 100 Carlson Road, Rochester 3, N. Y. Hubbard 2-2200

Stromberg-Carlson-San Diego, 1895 Hancock St., San Diego 12, Calif. CYpress 8-8331

Stromberg Time Corp., 135 So. Main St., Thomaston, Conn. ATlas 3-4381

Sturrup, Inc., 50 Silver St., Middletown, Conn. DI 6-9681

Sturtevant Co., P. A., Addison, Ill. TErrace 4-2000
(See advertisement on page 196)

Stylograph Corp., 205 W. Main St., Rochester 4, N. Y.

Sunshine Scientific Instrument, 1810 Grant Ave., Philadelphia 15, Pa. ORchard 3-5600

Superior Electric Co., 83 Laurel St., Bristol, Conn. LUdlow 2-9561

Superior Flux & Mfg. Co., 1536 St. Clair Ave., Cleveland 14, Ohio.

Superior Tube Co., Box 191, Norristown, Pa. BRoadway 5-2070

Surface Checking Gage Co., 5880 Hollywood Blvd., Hollywood 28, Calif. HOllywood 32518

Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio. IVanhoe 1-0780

Swiss American Jewel Bearings Co., 42 Cherry Lane, Floral Park, L. I., N. Y. HUnter 8-2600
(See advertisement on page 154)

Swiss Jewel Co., Lafayette Bldg., Philadelphia 6, Pa. WA 5-1990

Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill. SPring 4-1515

Switzer Brothers, Inc., 4732 St. Clair Ave., Cleveland 3, Ohio. EXpress 1-7070

Sylvania Semiconductor Div., Sylvania Electric Products Inc., 100 Sylvan Rd., Woburn, Mass.

Synchro-Start Products, Inc., 8151 N. Ridgeway Ave., Skokie, Ill. OR 3-7730
(See advertisement on page 60)

Syntron Co., 621 Lexington Ave., Homer City, Pa. GRidley 9-8011

Syracuse Electronics, 1014 E. Fayette St., Syracuse 10, N. Y. GRanite 2-0042

Systematics, Inc., 10 East 40th St., New York 16, N. Y. LExington 2-8181

Systron Corp., 950 Galindo St., Concord, Calif. MU 2-3650

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TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.

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Taurus Corp., 8 Coryell St., Lambertville, N. J. EXport 7-1570

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Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y. BEverly 5-5000

Technical Apparatus Builders, 109 E-Liberty St., New York 6, N. Y. REctor 2-6240
(See advertisement on page 111)

Technical Appliance Corp., 1 Taco St., Sherburne, N. Y. SHerburne 7-2211

Technical Associates, 140 W. Providencia Ave., Burbank, Calif. TH-8-6649
(See advertisement on page 125)

Technical Measurement Corp., 441 Washington Ave., North Haven, Conn. CEdar 9-2501

Technical Service Corp., 917-19 S. Third St., Louisville 3, Ky. JUniper 7-8476

Technique Associates, Div. of Duncan Electric Co., 1413 N. Cornell Ave., Indianapolis 2, Ind. ME-1-4904

Technitrol Engineering Co., 1952 E. Allegheny Ave., Philadelphia 34, Pa. GA-6-9105

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Tejax Engineering Corp., 180 Weeden St., P. O. Box 348, Pawtucket, R. I. PAwtucket 5-6788

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Teletronics Laboratory, Inc., 54 Klakel St., Westbury, L. I., N. Y. EDgewood 3-1027

Teletype Corp., 4100 Fullerton Ave., Chicago 39, Ill. SPaulding 2-1040

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Tempil Corp., 132 W. 22nd St., N. Y. 11, N. Y. ORegon 5-6610

Tempo Instrument Inc., Co., Commercial St., P. O. Box 338, Hicksville, N. Y. OVerbrook 1-2280

Tenney Engineering Inc., 1090 Springfield Rd., Union, N. J. MU 6-7870
(See advertisement on page 35)

Tensitron, Inc., 124-128 Harvard Depot Rd., Harvard, Mass. GLadstone 6-3511
(See advertisement on page 217)

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Texas Instruments Inc., Industrial Instrumentation Div., 3609 Buffalo Speedway, Houston 6, Texas. JAckson 6-1411

Texas Nuclear Corp., Box 9267, Austin 17, Tex. GI 3-7288

Thayer Scale Corp., 1 Thayer Park, Hanovar, Pembroke, Mass. TAylor 6-2371

Thermal American Fused Quartz Co., 15-19 Salem St., Dover, N. J. Foxcroft 6-2807

Thermax Wire Corp., 304 E. 45th St., New York 17, N. Y. MU-8-8648

Thermco Instrument Corp., U. S. 20, LaPorte, Ind. Telephone 5158
(See advertisement on page 39)

Thermo Electric Co. Inc., 109 5th St., Saddle Brook, N. J. HUbbard 9-5800
(See advertisement on pages 45, 56, 66, 95, (See advertisement on page 217)

Thermo Electric Mfg. Co., P. O. Box 697, Dubuque, Iowa. Telephone 3-3501

Thermo-Fax Div., Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. PRospect 6-8511

Thermo Products Co. Inc., 3727 No. Palmer St., Milwaukee 12, Wis. LOcust 2-5800

Theta Instrument Corp., 48 Pine St., East Paterson, N. J. SWarthmore 7-7700

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Thomas Engineering Inc., D. W., 367 W. 7th St., San Pedro, Calif. TErminal 1-1206

Thompson Clock Co., H. C., 38 Federal St., Bristol, Conn. LUdlaw 2-3186

Thompson-Ramo-Wooldridge Products Co., Div. of Thompson Ramo Wooldridge, Inc., 202 N. Canon Dr., Beverly Hills, Calif. BRadshaw 2-8892

Tiffen Optical Co., 71 Jane St., Roslyn Heights, L. I., N. Y. MAyfair 1-2700
(See advertisement on page 169)

Tigerman Engineering Co., 4332 N. Western Ave., Chicago 18, Ill. IR 8-9841
(See advertisement on page 45)

Times Facsimile Corp., 540 W. 58th St., New York 19, N. Y. JUdson 2-3030

Times Wire & Cable Co., 358 Hall Ave., Wallingford, Conn. COlony 9-3381

Tinsley Laboratories, Inc., 2526 Grove St., Berkeley 4, Calif.
(See advertisement on pages 134, 164)

Tobe Deutschmann Corp., 921 Providence Hwy., Norwood, Mass.

Torrington Company, 59 Field Street, Torrington, Conn. HUnter 2-4441

Torsion Balance Co., 35 Monhegan St., Clifton, N. J. GRegory 3-6900

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Traid Corp., 17136 Ventura Blvd., Encino, Calif. ST 3-3373

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Trans-Sonics, Inc., Wheeler Road, Burlington, Mass. BRowning 2-1000

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Trinity Equipment Corp., Route #281, Cortland, N. Y. SKyline 6-7535

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Branch: 75 Wilcox Rd., Milford, Conn.

Triplett Electrical Instrument Co., Harmon Road, Bluffton, Ohio. Telephone 323-W

Tri-R Instruments, 144-13 Jamaica Ave., Jamaica 35, N. Y. JAmaica 3-0041
(See advertisement on page 66)

Tri-Tronics Co., 2607 St. Charles Rd., Bellwood, Ill.

Tronex, Inc., G Street, Millville, N. Y. TAylor 5-1750

Trott Electronics, Inc., 412 Smith Street, Rochester 6, New York. HAmilton 6-0150

Tube Turns Plastics, Inc., 2929 Magazine St., Louisville 11, Ky. SPring 5-6431

U

Uehling Instrument Co., 473 Getty Ave., Paterson 3, N. J. SHerwood 2-8710
(See advertisement on page 220)

Ulanet Company, George, 419 Market St., Newark, New Jersey
(See advertisement on page 68)

Ultradyne, Inc., 2624 San Mateo, N. E., Albuquerque, N. Mex. AMherst 8-2431

Ultra-Violet Products, Inc., 5114 Walnut Grove Ave., San Gabriel, Calif. CUmberland 3-3193

Ultronix, Inc., 111 East 20th Ave, San Meteo, Calif. FIreside 5-7921

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(See advertisement on page 135)

Ungar Electric Tools, Inc., 4101 Redwood Ave., Los Angles 66, Calif. EXmont 8-5718

Uniflow Valve Corp., 19 Quine St., Cranford, N. J. BRidge 6-8300

Uniform Tubes, Inc., Collegeville, Pa. HUxley 9-7276

Unimax Switch Div., W. L. Maxson Corp., Ives Road, Wallingford, Conn.

Union Switch & Signal Div., Westinghouse Air Brake Co., Pittsburgh 18, Pa. CHurchill 2-5000
(See advertisement on pages 81, 174)

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United Aircraft Products, Inc., 1116 Bolander Ave., Dayton, Ohio. BAldwin 4-3841

United Control Corp., 4540 Union Bay Place, Seattle 5, Wash. LA 5-9200

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United Electrodynamics, Inc., 200 Allendale Rd., Pasadena, Calif. MUtual 2-1134

United Engineers, Inc., 824 East 6th St., Tulsa 20, Okla. LUther 5-1027

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U. S. Electrical Motors Inc., 200 E. Slauson Ave., Los Angeles 54, Calif. ADams 3-3131

U. S. Electronics Corp., 275 Warren St., Lyndhurst, N. J. GEneva 8-2400

U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa. ALpine 7-6531
(See advertisement on page 47)

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United Transformer Corp., 150 Varick St., N. Y. 13, N. Y. ALgonquin 5-3500

Unitron Instrument Div., United Scientific Co., 204-6 Milk St., Boston 9, Mass. HA-6-9878
(See advertisement on page 137)

Universal Drafting Machine Corp., 7960 Lorain Ave., Cleveland 2, Ohio. OL 1-4747

Universal Dynamics Corp., P. O. Box 9814, Arlington 9, Va. JAckson 5-4541

Universal Electronics Co., 1720-22nd St., Santa Monica, Calif. EXbrook 3-7707
(See advertisement on page 110)

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Universal Match Corp., Armament Div., P. O. Box 5841, St. Louis 21, Mo.

Universal Toroid Coil Winding Inc., 171-IC Coit St., Irvington 11, N. J. ESsex 4-9800

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(See advertisement on pages 161, 189)

Vanguard Instrument Corp., 20 W. Centennial Ave., Roosevelt, L. I., N. Y. FReeport 8-8070

Van Products Co., 5755 Swanville Road, Erie, Pa. TEmple 3-5556

Van Norman Industries Inc., Electronics Div., 186 Granite St., Manchester, N. H. NAtional 5-9701

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Varflex Corp., 512 W. Court St., Rome, N. Y. Telephone 7200

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Varo Mfg. Co. Inc., 2201 Walnut St., Garland, Texas. BRoadway 6-6141

Vector Electronic Co., 1100 Flower St., Glendale 1, Calif. CH 5-1076
(See advertisement on page 132)

Vectrol Engineering Inc., P. O. Box 1089, Stamford, Conn. DAvis 4-4602

Vee-Arc Corp., 50 Milk St., Westboro, Mass. FOrest 5-4451
(See advertisement on page 190)

Veeco Vacuum Corp., 86 Denton Ave., New Hyde Park, L. I., N. Y. Pioneer 6-1161

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(See advertisement on page 20)

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Vickers, Inc., Electric Products Div., 1815 Locust St., St. Louis 3, Mo. CEntral 1-5830

Victor Equipment Co., 844 Folsom St., San Francisco 7, Calif. GArfield 1-3000

Victory Engineering Corp., P. O. Box 373, Springfield Rd., Union, N. J. MUrdock 8-7150

Vinson Mfg. Co., Inc., 8044 Woodley Ave. Van Nuys, Calif. STate 6-7210

Virginia Electronics Co., Inc., River Road and B&O R. R., Washington 16, D. C.

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Vought Co., P. O. Box 1350, Beverly Hills, Calif. CHestview 6-1131

W

Wabash Metal Products Co., Wabash, Indiana
(See advertisement on page 190)

Waber Electronics, 105 Heatherwood Rd., Havertown, Pa. Hilltop 7-1279

WacLine, Inc., 35 S. St. Clair St., Dayton 2, Ohio.

Waldom Electronics Inc., 4625 W. 53rd St., Chicago 32, Ill. LUdlow 5-1212

Walkirt Co., 141 W. Hazel St., Inglewood 3, Calif., ORegon 8-4814

Wall Colmonoy Corp., 19345 John R., Detroit 3, Mich. TWinbrook 3-3800

Wallace & Tiernan, Inc., 25 Main St., Belleville 9, N. J. PLymouth 9-8000
(See advertisement on pages 44, 48, 49, 50)

Walser Automatic Timer Corp., 420 Lexington Ave., New York 17, N. Y. LEx 2-9774

Waltham Horological Corp., 400 Lynnway, Lynn, Mass.

Wang Laboratories, Inc., 37 Hurley St., Cambridge 41, Mass. UNiversity 4-8380

Ward Leonard Electric Co., Mt. Vernon, N. Y. MO 4-1000

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(See advertisement on page 43)

Warwick Products, 1572 Riverbed, Cleveland 13, Ohio. Ch 1-6260
(See advertisement on page 157)

Waterman Products Co., Inc., 2445 Emerald St., Philadelphia 25, Pa. GArfield 6-8600
(See advertisement on page 92)

Waugh Engineering Co., 7842 Burnet Ave., Van Nuys, Calif. STate 2-1710
(See advertisement on page 37)

Waukee Engineering Co., Inc., 5136 North 35th St., Milwaukee 9, Wis. UPtown 1-5413

Waukesha Motor Co., St. Paul Ave., Waukesha, Wis. LIberty 7-7995

Waveline, Inc., P. O. Box 718 Passaic Ave., W. Caldwell, N. J.

Waxon-Carbeff, Inc., 8 Commercial St., Rochester 14, N. Y. HA 6-1240
(See advertisement on page 156)

Weatherhead Co., Ft. Wayne Div., 128 W. Washington Blvd., Ft. Wayne, Ind. E-8055

Webber Engineering Corp., P.O. Box 217, Indianapolis 6, Ind. MElrose 2-1378

Weckesser Co., 5701 N. Northwest Highway, Chicago 46, Ill. ROdney 3-6688 TWX CG 3015

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1807 Elmwood Ave., Buffalo 7, N. Y. DE-3229

Weinschel Engineering, 10502 Metropolitan Ave., Kensington Md. LOckwood 4-0122

Weiss & Son, Inc., Albert A., 263 Vanderbilt Ave., Brooklyn 5, N. Y. NE 8-0777

Weksler Instruments Corp., 195 E. Merrick Rd., Freeport, L.I., N. Y. MAyfair 8-0100
(See advertisement on page 55)

Welch Electric Co., 1221 Wade St., Cincinnati 14, Ohio. MAin 1-7122

Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill. MIchigan 2-2000

Wells Electronics Co., 1701 S. Main St., South Bend 23, Ind. AT-3-4651

West Instrument Corp., 4363 W. Montrose Ave., Chicago 41, Ill. AVenue 6-1007

Westamp, Inc., 11277 Massachusetts Ave., Los Angeles 25, Calif. GR 88394

Westberg Mfg. Co., Box 239, Napa, Calif. BAldwin 6-5218

Western Apparatus Co., Div. of Comptometer Corp., 2001 Greenleaf, Evanston Ill., UNiversity 9-9500

Western Design, Div. of U. S. Industries, Inc., Santa Barbara Airport, Goleta, Calif. WOodland 7-4571

Western Devices, Inc., 600 W. Florence Ave. Inglewood, Calif.
(See advertisement on page 171)

Western Electronic Products Co., 655 Colman St., Altadena, Calif. SYcamore 4-6379
(See advertisement on page 218)

Western Gear Corp., Electro Products Div., 132 W. Colorado St., Pasadena, Calif.

Western Insulated Wire Co., 2425 E. 30th St., Los Angeles 58, Calif. Ludlow 7-7103

Western Radiation Laboratory, 1107 W. 24th St., Los Angeles 7, Calif. RIchmond 7-8355

Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, Pa.

Westinghouse Electric Corp., Director Systems Dept., 356 Collins Ave., Pittsburgh 6, Pa. EM 2-2500

Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Pa. WA 5-7272

Westline Products Div., 600 E. 2nd St., Los Angeles 54, Calif. MAdison 7-2641

Weston Hydraulics Ltd., Sub. of Borg-Warner Corp., 10918 Burbank Blvd., No. Hollywood, Calif. STanley 7-3201

Weston Instruments Div., Daystrom, Inc., 614 Frelinghuysen Ave. Newark 12, N. J. BIgelow 3-4700

Westronics, Inc., 3605 Mc Cart St., Ft. Worth, Texas. WA 3-8211

Wheeler Electronic Corp., Subsidiary of Sperry Rand Corp., 150 E. Aurora St., Waterbury 20, Conn. PLaza 4-5191

Wheeler Manufacturing Co., C. H., 19th & Lehigh Ave., Philadelphia 32, Pa.

Wheelock Signals, Inc., 273 Branchport Ave., Long Branch, N. J. CApital 2-6880

White Dental Mfg. Co., S. S., Industrial Div., 10 East 40th St., New York 16, N. Y. MU-3-3015

White Instrument Laboratories,. P. O. Box 9006, Allandale Station, Austin 17, Tex. GLendale 3-8447

Whitney Blake Co., 1537 Dixwell Ave., New Haven 14, Conn. Chestnut 8-5515

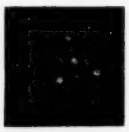
Wiancko Engineering Co., 255 Halstead Ave., Pasadena, Calif. RYan 1-4471

Will Corporation, Wilco Drive, Rochester 3, N. Y. BRowning 1-8200

Williams Apparatus Co., Inc., Herald Bldg., Watertown, N. Y. SU 2-3420

Wilmington Fibre Specialty Co., New Castle, Del. EAst 8-7525

Wilson & Co., G. C., 1915 8th Ave., Huntington W. Va. JA 3-5149
(See advertisement on page 218)



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Wood, N. Counter Laboratory, 1525 E. 53rd St., Chicago 15, Ill. FAirfax 4-1114

Worcester Valve Co., Inc., Worcester 10 Mass.
(See advertisement on page 71)

Worden Labs., 695 Rocky River Rd., Houston 27, Tex. MOhawk 7-0755

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(See advertisement on page 123)

Zenith Electric Co., 152 W. Walton St., Chicago 10, Ill. MI-2-3322
(See advertisement on page 69)

Zenith Optical Laboratory, 1940 Great Neck Rd., Copiague, L. I., New York. Amityville 4-4616
(See advertisement on page 180)

Zernickow Co., O., 15 Park Row, New York 38, N. Y. BArclay 7-2264
(See advertisement on page 62)

Zero-Max Co., 1900 Lyndale Ave., So., Minneapolis 5, Minn. FRanklin 4-5520
(See advertisement on page 60)

Zippertubing Co., 752 S. San Pedro St., Los Angeles 14, Calif. MAdison 4-6664

Zoomar, Inc., 55 Sea Cliff Ave., Glen Cove, L. I., N. Y. ORiole 6-1900
(See advertisement on page 170)

Zophar Mills, Inc., 112-26th St., Brooklyn 32, N. Y. SOuth 8-0907

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Aerotest Laboratories, Inc., 129-11 18th Ave., College Point 56, N. Y. INdependence 1-7272

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Greiner Co., Emil, 20 N. Moore St., New York 13, N. Y. WO-6-4700

New York Scientific Supply Co., Inc., 28 W. 30th St., New York 1, N. Y. LE-2-2981

Palo Laboratory Supplies, Inc., 81 Reade St., New York 7, N. Y. COrtlandt 7-0075

Will Corporation, Wilco Drive, Rochester 3, N. Y. BRowning 1-8200

Wisconsin Science Supply Co., 1419 Underwood Ave., Milwaukee 13, Wis. BLuemound 8-4450

Heil Scientific, Inc., 214 S. 4th St., St. Louis 2, Mo.

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Avnet Corporation, 5877 Rodeo Rd., Los Angeles 16, Calif. TE-0-6141

Electro Tech Equipment Co., 308 Canal St., New York 13, N. Y. WO-6-2350

Electronic Enterprises, 124 N. Third St., Philadelphia 6, Pa. WAlnut 5-4930
(See advertisement on page 204)

Hughes Co., Kenneth E., 4808 Bergenline Ave., Union City, N. J. UNion 7-3204
(See advertisement on page 208)

Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N. Y. AX-1-7000
(See advertisement on page 95)

Lectronic Research Labs., 715 Arch St., Philadelphia 6, Pa. MArket 7-6771

Newark Electric Co., 223 W. Madison St., Chicago 6, Ill. ST-2-2944
(See advertisement on page 212)

Peerless Radio Distributors, Inc., 92-32 Merrick Rd., Jamaica 33, N. Y. JAmaica 8-3456

Relay Sales, Inc., Box 186, West Chicago, Ill. Telephone West Chicago 1100

Schweber Electronics, 60 Herricks Rd., Mineola, L.I., N. Y. PIoneer 6-6520

Tripoli Electronics Co., 1949 W. Erie St., Chicago 22, Ill. TAylor 9-8580

Universal Relay Corp., 42 White St., New York 13, N.Y. WAlker 5-9642
(See advertisement on page 175)

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UEHLING INSTRUMENT COMPANY

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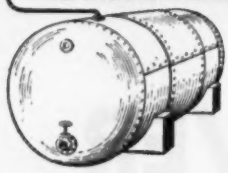
Recording, Indicating and Control Apparatus

UEHLING TANK-O-METER



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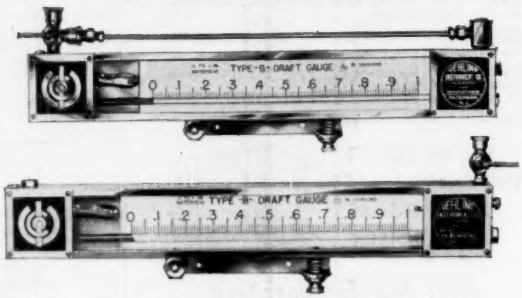
TANK-O-METERS may be applied to the measurement of ACIDS, ALKALIS, WATER, OIL, GASOLINE, ALCOHOL, BEVERAGES, TAR, MOLASSES, MILK, PAINTS, VARNISHES, SODIUM SILICATE, SOLVENTS, OR ANY OTHER CHEMICAL SOLUTION. *Send for Bulletin No.* 945.

INCLINED DRAFT GAUGES
For Plus or Minus Pressure
For Differential Pressure



The Uehling Draft Gauges are available with scales from 10" to 70" and waterheads ranging from 1" to 14". Scales are graduated for every 1/100" of waterhead. Each instrument is housed in a durable aluminum case with glass front and adjustable scale. They are extremely accurate as each instrument is individually calibrated. Furnished for draft, pressure, or differential pressure. *Send for Bulletin* 1146.

U-TUBES (STRAIGHT TUBE TYPE)

Uehling U-Tube Pressure and Vacuum Gauges consist of straight Pyrex tubes with a bottom metal connecting base, housed in aluminum case with glass front.

Each instrument has an external micrometer scale adjustment, zero check cock, and drain valve.

Scale lengths from 10" to 100".

Four indicating fluids.

Special calibration on request.

Send for Bulletin 828.

TEL-FLO METER

For measuring flow rates and purging line. Are accurate, exceptionally durable, and attractive. Housed in aluminum case with plastic front to protect graduated glass tube. Can be furnished in aluminum, brass, or stainless steel bodies (or any other metal). Suitable for maximum pressures of 300 lbs. Higher pressures upon request. Furnished with or without control valve and with either top, side, or back connection.

Send for Bulletin 553.

SPECIAL TANK-O-METERS

For fuming liquids, such as hydrochloric acid, nitric acid, propane, butane, ammonia, ethyl chloride, etc.

PRESSURE AND VACUUM GAUGES

Meet the most exacting requirements and combine accuracy, reliability, simplicity and durability. Housed in durable Aluminum cases with glass fronts. Standard instrument covers a range of 31 inches of mercury head. A catch-all for trapping visibly shows any condensate in the connecting line. Each scale has a knurled micrometer screw adjustment. A simple means is provided for cleaning the Pyrex manometer. May be calibrated in any desired units for pressure or vacuum and may be provided with a plus or minus scale to read either vacuum or pressure on the same instrument. Length to suit any range. Greater flexibility is made possible by choice of either mercury or one of three other indicating fluids.

Send for Bulletin 147.

MERCURIAL BAROMETERS

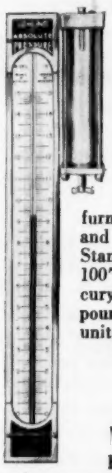
The Uehling Mercurial Barometer is furnished with a scale range of 20" to 31" of mercury graduated for every 1/10", with external vernier scale adjustment which provides readings of .01 of an inch of mercury throughout the range of 20" to 31" of mercury, or with a scale range of 500 to 780 millimeters of mercury graduated for every 1 millimeter with external vernier scale adjustment, which provides readings of .1 millimeter of mercury.

It can be furnished for flush mounting or surface mounting with or without oak panel board.

Send for Print 1155.

CIRCLE 403 ON READER-SERVICE CARD

MERCURY COLUMN ABSOLUTE PRESSURE INDICATORS



Uehling Mercury Column Absolute Pressure Gauges are designed for exacting requirements of modern engineering practice, and combine accuracy, reliability, simplicity, and durability. Used with all processes where extremely accurate absolute pressure determinations are essential. Can furnish catch-all for trapping and showing any condensate. Standard scale lengths of 7" to 100", graduated in 1/10" of mercury absolute pressure or in pounds or in equivalent metric units.

Send for Bulletin 247.

COMBINED BAROMETER AND VACUUM RECORDER

Records barometric pressure and vacuum on same chart. Distance between the two recorded lines represents the absolute pressure. Permanent accuracy and remarkable legibility are the outstanding characteristics of this recorder. Accuracy is obtained by the employment of the mercury column principle and consequently this recorder has the same high degree of accuracy as the mercury column indicator. It employs no springs, diaphragms, or multiplying levers, therefore holds its calibration permanently without readjustment.

Send for Bulletin 150.

UEHLING VACUUM RECORDER

Same as above, without barometric pen.

Send for Bulletin 140.

MOELLER INSTRUMENT COMPANY

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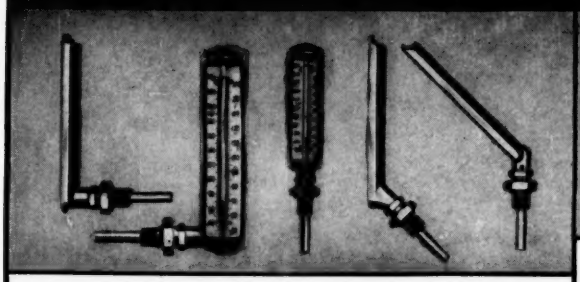
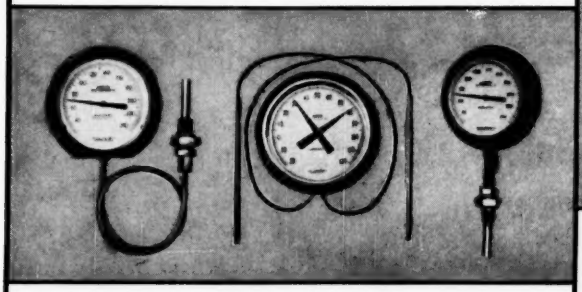
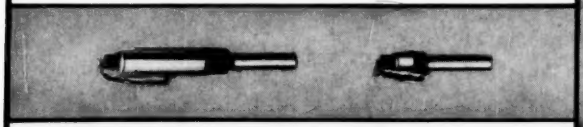
Representatives in Principal Cities



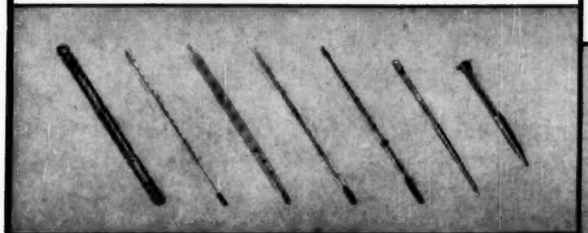
MOELLER INDUSTRIAL THERMOMETERS made in all forms, Straight, Angle, Right Side Angle, Left Side Angle, Reclined and Inclined Angles, in scale ranges from minus 120 to plus 1125°F. or its equivalent in centigrade. Available in 5″, 7″, 9″ and 12″ scale sizes with plain stems, union connection stems and separable sockets in all stem lengths and alloys.



DIAL INDICATING THERMOMETERS, Mercury Actuated, made in 4½″, 6″ and 8½″ sizes with flexible extension tubing. Adjustable rigid stems, single or two pointers, plain bulb, union connection bulb or separable sockets in all lengths and alloys. Scale ranges from minus 40 to plus 1000°F. or its equivalent in centigrade.



THERMOMETER TEST WELLS, THERMOCOUPLE PROTECTING TUBES and WELLS, made up in all sizes and alloys.



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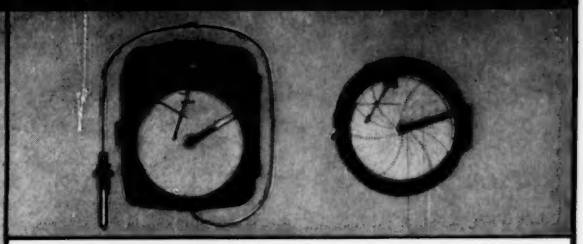

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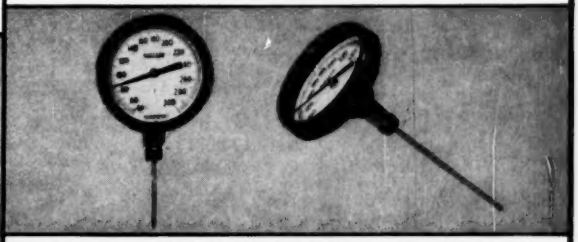
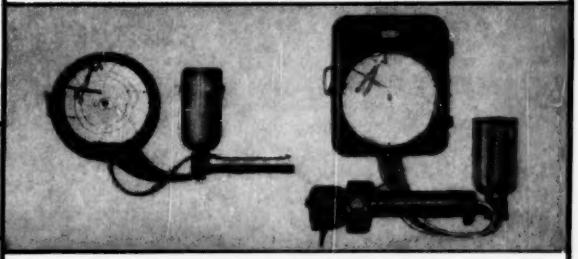
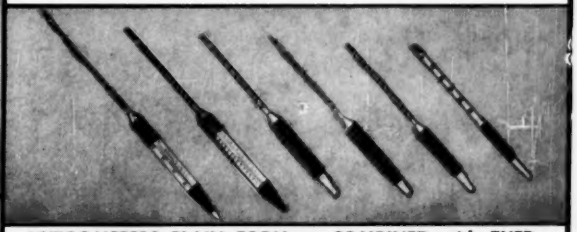


MOELLER BIMET THERMOMETERS are actuated by a powerful, specially processed bi-metal helix. Made in 5″ and 3″ diameter case size. Rigid stainless steel stem, can be furnished with union connection stem and separable socket in all alloys. Scale ranges from minus 100 to 1000°F or equivalent in centigrade.



RECORDING PSYCHROMETERS, Mercury Actuated. Round and Rectangular Case, 12 hour, 24 hour or 7 day charts, self contained or remote reading, with or without motor driven fan.



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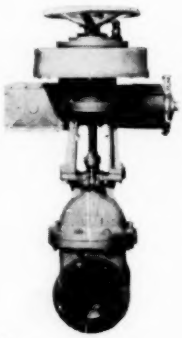
HAMMEL-DAHL

Now combined with the Foster Engineering Division in a modern 112,000 square foot plant in Warwick, Rhode Island, the Hammel-Dahl Division produces a complete line of pneumatic control valves—diaphragm or piston operated, split or integral bodies for every application.



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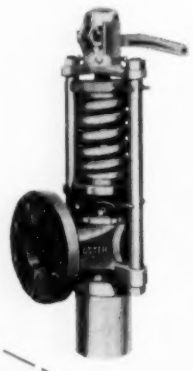
These powerful electric gear-driven actuators are designed to convert manual valves to automatic without removing valve bodies from line. Eliminates costly down time—ideal for centralized control from remote point.



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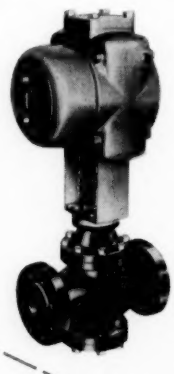
Long a prominent "name" in the field of heavy duty steam reducing valves, regulators, high pressure safety valves, and a pioneer of the famous Gentile® flow tube, the Foster Engineering Division adds a new dimension to the General Controls line of industrial control valves and accessories.



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A product of General Controls own research and development program, the Hydramotor® is one of the most widely used industrial valves in the country. By combining the powerful electro-hydraulic operators with a variety of valve bodies, the Hydramotor® offers tremendous power for high-pressure, high-flow applications. Fail-safe, simple two-wire control.

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